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*On Connecticut Route 86 a Few Miles Above Lyme. Backwater From Connecticut River. Highwater Level Is Indicated by the Line of Light Colored Debris in Middle Foreground. A 1½ Mile Earth Detour Passed Traffic by This Point Safely. The Driver of the Little Car Should Have Taken It*

*All Photographs by Field Editor, Roads and Streets*

# FLOOD EFFECTS ON NEW ENGLAND STREETS AND HIGHWAYS

By JOHN C. BLACK
*Field Editor, Roads and Streets*

I WAS fortunate in being able to traverse portions of the New England flood areas between March 22 and March 30, following the top stage of the rivers by from 1 to 6 days, and observing the condition of streets and highways as the water receded. In general these conditions were much better than was to be expected, the damage having been distinctly localized, while mile after mile of road emerged in apparently perfect condition. This applies to all types of surfaces. Hidden injuries may, and probably do, exist but not on a large scale.

The chief lessons of the disaster relate to location and bank protection rather than to pavement or sidewalk construction, though under certain conditions in town and city streets the latter become of paramount importance. Simple inundation—even where many feet deep—did no damage whatever in most cases, but swift currents wrought havoc—both by side cutting and tearing out from the top—and it is in this latter connection that improved construction should be considered.

I should have preferred to go direct from New York to Hartford, but as roads were reported impassable, the practical course was to follow the coast to Boston. The first flood evidence appeared at the Connecticut River crossing between Saybrook and Lyme, where the water was conspicuously high, but with little damage to property because of its wide spread over marsh land.

Turning inland on State Route 86, east of the river, we found the first trouble a few miles north of Lyme, where backwater covered a dip in the road. It looked fordable, but profiting from the experience of a motorist who had just tried it unsuccessfully from the opposite direction, we took a 1½ mile earth road detour which had been hastily constructed by State forces. There was no evidence of injury to Route 86.

*At Haverhill, Mass., the River Had Moved This Barn Out Into the Road. The Truck at the Left Was Being Used to Push It Back to Its Concrete Foundation Just Beyond the Group of Men*

*Where an Eddy Current Washed Out a Bituminous Macadam Road in East Hartford. This View Looks South From Connecticut Boulevard at a Point a Few Hundred Feet East of "Dry Bridge" Over Relief Channel Which Ordinarily Carries No Water*

*Darlin Street, East Hartford, Looking North Across Connecticut Boulevard*

*Hartford: Looking North on Commerce Street at Sheldon Street. Deep Washout on Each Side of Commerce Street, Which Is on a Considerable Grade at This Point. Large Portions of Sheet Asphalt Surface Completely Stripped From Concrete Base. Steam Pump in Background Is Drawing Off Basement Water Through the Sewer*

*Washed-out Sidewalk on South Side of Connecticut Boulevard East of "Dry Bridge" in East Hartford. This Was Caused by the Same Eddy Current Which Destroyed Bituminous Pavement Shown in Another View. The Pavement on Connecticut Boulevard Was Undamaged; Curb and Gutter Suffered Slightly*

The bridge at East Haddam was carrying traffic efficiently although water had recently been over the deck and was still up to the lower chord of the deck approach span at the west end. Some short stretches of road between East Haddam and New London had been inundated with apparently no damage.

*Rhode Island Escaped.*—Rhode Island suffered no highway injuries according to statements of Department of Public Works officials. State highways were closed at only two points, at each of which a ½-mile detour carried traffic safely around. Both closures were of short duration.

*Along the Merrimac River.*—There was a different story on Massachusetts State Route 110 along the north bank of the Merrimac River between Haverhill and Lowell. There the river had gone on a rampage with results differing according to location. At and near Haverhill the water had come over the bank, undermining electric railway tracks adjoining the highway, undercutting the pavement, and breaking out a few square yards of concrete at several points. The pavement damage was not on a large scale, and was under repair when we arrived.

The road was closed to traffic, but the guards courteously passed us the entire distance when we stated our business. Had we been a day earlier we should have had to detour around heavy deposits of silt between Lawrence and Lowell. These were cleared for only part of the pavement width when we passed, and several large gangs were busy shoveling the remainder into trucks. The entire width of the pavement for many hundred feet had been covered to a depth of approximately 2 ft., while at places the deposit was considerably thicker. At one point where the mud was only a few inches deep a one-way snow plow was being used, apparently to some advantage. One of the foremen stated that a V-type plow had been tried but had promptly broken down.

At the south end of the bridge on State Route 28 at Lawrence a stretch of granite block pavement was washed out, the damage extending to and including a part of the bridge abutment. The damage here, as at many other places, resulted from scouring by eddy currents induced by a sharp angle in the stream bank. An interesting feature at this point was that many of the paving blocks were broken straight through, the breaks extending along a joint, across a block, along the next joint, across the next block, and so on. Mr. R. W. Priestman, City Engineer of Lawrence, informs me that these blocks were grouted with a mixture, 1 cement : 1½ sand.

A sticking camera shutter ruined all but two of my pictures along the Merrimac—a great disappointment, as some of the scenes were unique.

*Hartford and East Hartford.*—At Hartford and East Hartford damage to streets and sidewalks was conspicuous but again less extensive than I had expected to find. With almost no exceptions it was due to swift currents induced by constriction of channel or by sharp angles in the stream bank.

The effect of channel constriction was most evident at streets and alleys running in the direction of river flow. The views at Darlin Street in East Hartford and the alley off Sheldon Street in Hartford proper show these effects clearly. The Darlin Street picture was taken looking north at Connecticut Boulevard, facing the direction from which the flood came. The boulevard is a wide thoroughfare with comparatively few buildings on its north side to check the flow. The more solidly built south side, however, presented a substantial barrier, forcing the flood into the narrow north and south streets, with results as shown. The breaks appear generally to have begun at the sidewalks, and once started, to have progressed by a rapid washing-out of the subgrade. Highwater mark at Darlin Street was about 5 ft. above the Connecticut Boulevard sidewalk level.

The alley off Sheldon Street also had a north and south direction. The street at this point was undamaged and so was the sidewalk a few feet on each side beyond the alley entrance. A similar example on a still smaller

*Granite Block Pavement on Route 28 at Lawrence. A Sharp Change in Direction of River Bank Induced the Current Which Did This Damage*

*Hartford: Looking Easterly on Sheldon Street at Commerce Street. Conditions a Few Yards Farther West Indicated That a Strip of Open Ground Between Sidewalk and Building Had Led to Immediate and Rapid Undercutting. The Sheet Asphalt Pavement on Sheldon Street Was Little Damaged Though Undercut From 1 to 3 Ft. On Commerce Street the Same Type of Pavement Was Destroyed*

scale appeared nearby, where a 4 ft. space between buildings on the south side of the street had led to the undermining and collapse of a single sidewalk slab directly in front of the opening. This was the only visible damage in the vicinity.

*Where Pavements Should Be Solid.*—The main item in protecting such locations against future floods must be a tight and substantial surface, for once the water gets underneath, the damage will run its course. A solid slab —say 6 in. of portland cement or bituminous concrete with proper filling in any joints—over the entire area would save the street in many cases. Obviously there can be no grass plots, parking strips, or unprotected fills. Pavement, curb, sidewalk and building construction must

*More Washout of Sidewalk on South Side of Sheldon Street. Apparently the Weak Spot Here Was a Dry-Laid Masonry Wall Supporting the Street at the Property Line. The Pavement, Though Undercut a Foot or More, Was Undamaged. There Was No Damage to Walk or Pavement at North Side of Street. Less Constriction Here Than at Most Points of Damage*

all join tightly. If the cost of such construction is not warranted there seems little or nothing to be done.

*Problems of Bank-Cutting.*—Away from the built-up areas, two special conditions affecting pavements and walks were in evidence: first, the cutting of banks where the flood channel is narrow and the current consequently swift; and second, the cutting of banks by eddy currents at reentrant angles in the banks—usually at the intersection of a side road and the approach fill to a bridge.

The narrow channel is obviously a problem for the river and harbor or flood control authorities. If they can not provide protection the highway engineer must take his chance of a washout or move his road far enough back for safety. In the territory I visited, however, there was so little damage of this sort that there could be no question as to the propriety of the location. The locators had taken their chances wisely.

The eddy current problem was conspicuous, its effects being visible on both up-stream and down-stream sides of bridge approach fills and also on the fills or banks intersecting them. It is probable that protective measures would have been justified in at least some of these places. Again the solution of the problem lies in the field of river control, but the paramount interest of the highway engineer puts the initiative practically in his hands.

It must not be inferred from the comparatively small extent of the damage here described that the floods

*Another Point Where Flow Constriction Caused Damage. This 12 Ft. Alley on the South Side of Sheldon St. in Hartford, and the Walk in Front of It, Were Cut Out as Shown, Though the Sheldon St. Pavement and the Sidewalk a Few Feet at Either Side Were Undamaged*

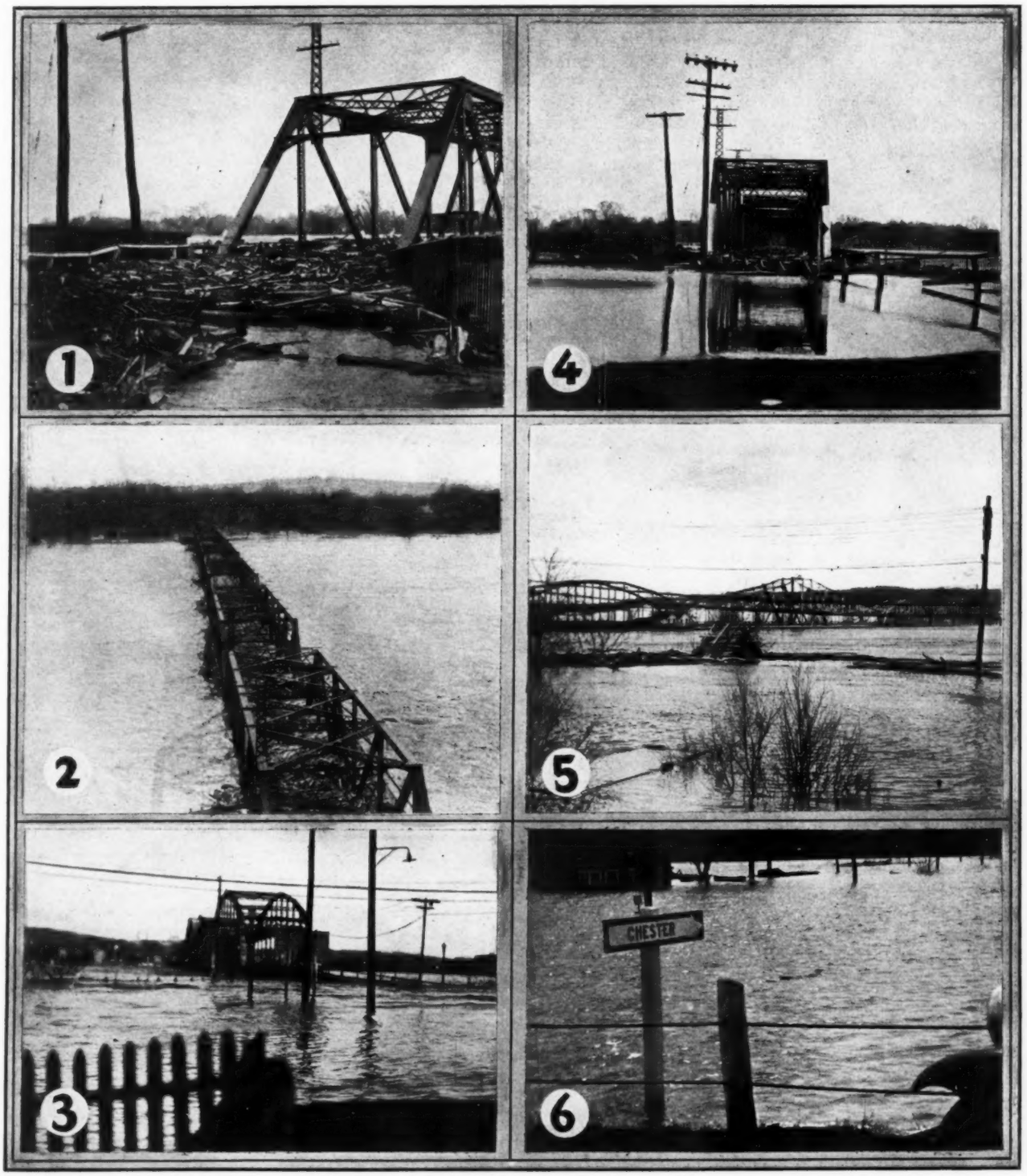
brought no major disaster to New England highways. A Massachusetts legislative committee, reporting on conditions in the upper Connecticut and Blackstone valleys, estimated that more than $13,000,000 would be necessary for repairs in those districts alone, the bulk of the requirement being for bridges. I regretted that my schedule did not permit a visit to these areas.

In Connecticut a number of bridges and culverts went out—the largest, a 40 ft. span—and road surfaces suffered in places, but the total damage to state highways was much less than in Massachusetts.

The quick restoration of roads to service is a matter of great credit to the highway departments of both Massachusetts and Connecticut, the officials having spared neither themselves nor their crews while the emergency lasted.

*At East Haddam, Connecticut, March 24*

# SCENES DURING THE CONNECTICUT FLOODS—MARCH, 1936




*Photographs by Courtesy of the Connecticut State Highway Department.*

1. *Debris Blocking Entrance to the Bridge Between Warehouse Point and Windsor Locks*
2. *Warehouse Point-Windsor Locks Bridge, With Debris on Floor and Against Trusses*
3. *Entrance to Middletown-Portland Bridge Blocked by the Flood*
4. *Before the Water Subsided, Warehouse Point-Windsor Locks Bridge*
5. *Water at the Lower Chord Level, Middletown-Portland Bridge*
6. *At the Junction of Route 9 and Route 148 in the Town of Chester*

# FLOOD DAMAGES TO BRIDGES AND HIGHWAYS IN MASSACHUSETTS

THE flood conditions in Massachusetts were severe during two periods from March 11 until March 15 and from March 19 to March 22.

The first flood period was most severe in the Connecticut Valley region and in the western and south central parts of the state. There were numerous landslides on the Mohawk Trail, Automobile Route No. 2; on the Berkshire Trail, Automobile Route No. 9; and on Automobile Routes No. 7, No. 8 and No. 112. There were several flooded sections of highways which had to be closed on Automobile Routes No. 5, No. 10, No. 116

*Huntington—Automobile Route No.* 112*—View Showing Crane Removing Ice Deposited by Flood*

and No. 63 along the Connecticut River Valley and a few other scattered sections in the south central and northeastern parts of the state. As the flood waters receded, many sections of the highways in the western and Connecticut Valley regions were covered by large cakes of ice many feet deep which had to be removed by steam shovels, cranes and snow plows. This first flood period

*Sandisfield—Automobile Route No.* 8*—View Showing Snow Plow Plowing Ice From the Roadway*

*Ashfield—Automobile Route No.* 116*—View Showing Typical Landslide*

and the resulting slides and ice conditions did not seriously damage the highways.

The second flood period was much more severe, and was effective in the Merrimac Valley region as well as the Connecticut Valley. Automobile Routes No. 113 and No. 110, which closely follow the banks of the Mer-

*Dracut—Automobile Route No.* 110*—View Showing Silt Deposited on Highway Which Has Been Plowed to the Sides*

rimac River for several miles, were completely inundated and had to be closed for several days.

As the flood waters rose two bridges which span the Connecticut River went out, the Montague City Bridge, which is a wooden covered bridge, and the Sunderland Bridge, which is a light steel through truss bridge. Several other bridges across the Connecticut River were covered with water and had to be closed until an examination could be made to determine the extent of the damage. Some of these bridges are damaged and will

have to be repaired or replaced before they will be opened to travel.

Several bridges across the Merrimac River were closed and it is probable that the bridge at Groveland will have to be replaced.

*Hatfield—Automobile Route No. 5—View Showing Typical Washout*

*Ashby—Automobile Route No. 119—View Showing Typical Washout*

*Northampton—Automobile Route No. 9—View Showing Flood Waters at Hadley Bridges*

*Hadley—Automobile Route No. 9—Hadley Bridge*

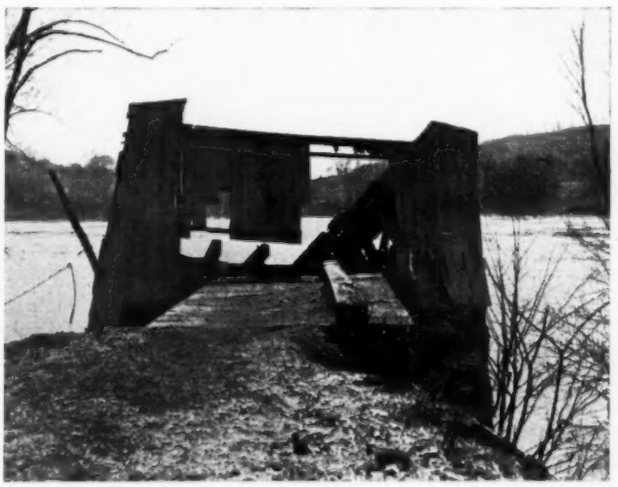
The bridges on the major routes which were destroyed or washed away are as follows:

| Town | Automobile Route |
|---|---|
| Montague | M |
| Sunderland | 116 |
| North Dana | 21 |
| Ware | 9 |
| Ware | 32 |
| Petersham | 32 |
| Barre | 32 |
| Princeton | 68 |
| Fitchburg | 120 |
| Princeton | 120 |
| Sterling | 64 |
| Sutton | M |
| Uxbridge | 126 |
| Pepperell | 113 |

Deep deposits of silt were left on many of the highways and in many cases, snow plows were used to plow this material to the sides of the road.

While most of the major highways are now (April 6) open for travel, except for sections where bridges are closed or have been destroyed, there are innumerable places where washouts and landslides have occurred and it will be several weeks before these places can be repaired and the roadway restored to normal.

We are indebted to G. H. Delano, Chief Engineer, Massachusetts Department of Public Works, for the above information and for the photographs.



*Montague—View Showing Remains of Montague City Bridge Which Was Washed Away*

# THE REGENERATION OF ENERGY

By HALBERT P. GILLETTE

THE law of the degradation of energy states that no transformation of energy occurs without some of it acquiring a longer wave length and coincidentally escaping into interstellar space. If there is no means by which this process is reversed then Sir James Jeans is right when he says: "Energy flows always in the same direction as water flows down hill. . . . With universes as with mortals, the only possible life is progress to the grave."

Jeans personifies the cocksureness of the average scientist. Although he was quick to adopt the Einstein theory of the transformation of matter into energy, he fails to reason from that revolutionary discovery that others quite as revolutionary lie just over the hill awaiting the uncovering shovels of the prospectors.

Prof. Henry Norris Russell, of Princeton, while admitting that scientific facts point toward the dissipation of energy, still believes that new facts may eventually point another way, for he says: "What we know so far exhibits the processes of nature as irreversible, and makes the dissipation of energy appear inevitable; but our knowledge of nature is limited, and any answer to questions of such scope as this must at present be purely speculative."

There is at least one fact that casts doubt upon Jeans' belief that all matter inevitably will become heat waves; and that is that in spite of the "infinite" age of the stars there are stars. If their age is really infinite, they should not exist, according to the theory of continuous and irreversible dissipation of energy. If their age is not infinite, some power either created them from nothing or re-created them from heat-quanta. The latter inference has at least analagy to support it; for nature is cyclic in countless ways.

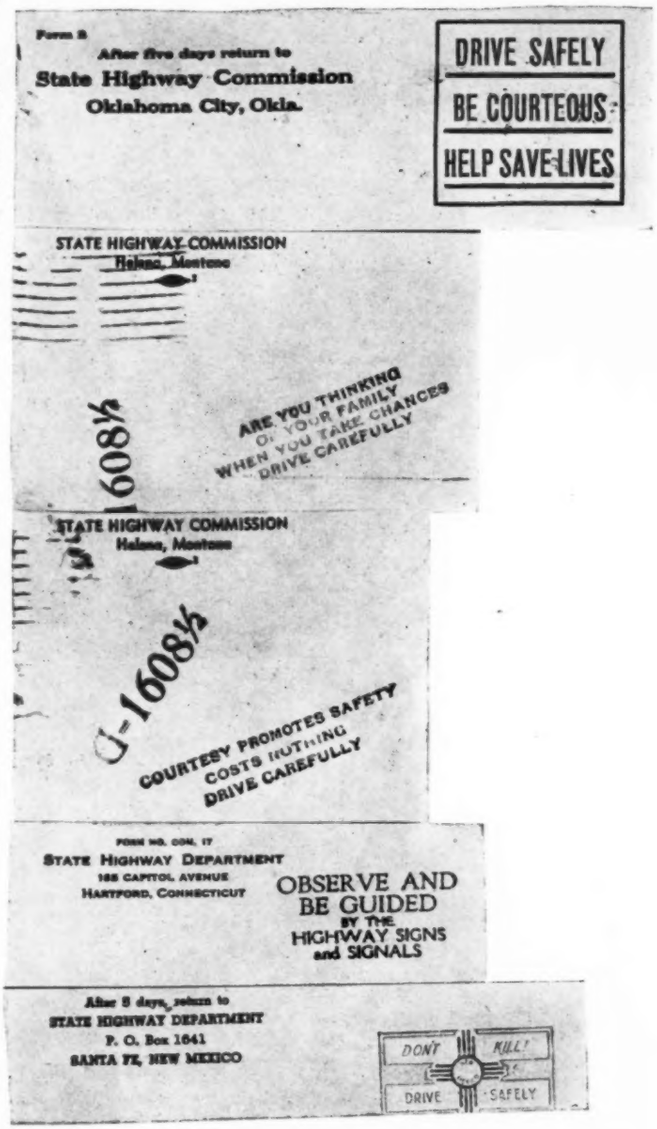
From electrical laws Lorentz deduced that an electron contracts as its velocity increases, and at the velocity of light it ceases to have any thickness at all. This is tantamount to saying that all its mass has been converted into energy waves or quanta when its velocity becomes that of light. Einstein later deduced the same result from his "relativity postulate." May we not infer that it is by virtue of a conversion of mass into radiant energy that an electron gains velocity? If so, then by losing velocity it gains mass and therefore absorbs radiant energy. On this hypothesis every mass that is losing velocity is absorbing radiant energy, and the process that Jeans calls irreversible is actually reversed.

It has recently been discovered that the velocities of electrons can be enormously increased by causing them to circulate around a magnet. A machine called a "cyclotron" has been invented for the purpose of thus imparting enormous velocities to electrons—velocities of the order of 20,000 miles a second. Since the earth is a magnet, it may, I think, be regarded as one of nature's numberless cyclotrons that not only attract electrons that come near it, but impart to them increased velocity of rotation. There are undoubtedly several electron-shells that encase the earth, each of which is a magnet, and therefore a cyclotron. Every cyclonic or anti-cyclonic air-whirl contains a predominant number of electrons, is a magnet and is therefore a cyclotron. This explains the ability of such whirls to not only maintain their existence for days but to grow in intensity for a considerable time.

The very genesis of planets and of stars may depend upon this cyclotron process. Yet before the cyclotron was invented, physicists could see no way in which electrons cast into space by the sun and other stars could again coalesce, much less congregate so as to produce axially rotating masses like our sun.

In pure science, as in invention, the "impossibility" of today may become the reality of tomorrow.

## Drive Safely Slogans




*Several state highway departments are now using highway accident prevention slogans on their mailing pieces. Above are shown the envelopes of four departments. It would be worth while if every post office cancelling stamp machine carried a slogan that would bring forcibly to automobile drivers the need for driving more carefully.*

*Fig. 3—Portable Hot Mix Asphalt Plant on East Jordan Contract*

# OIL AGGREGATE CONSTRUCTION IN MICHIGAN BY PLANT MIX METHOD

By J. G. SCHAUB

*Assistant Construction Engineer, Michigan State Highway Department*

THE Michigan State Highway Department in its specifications adopted Sept. 1, 1934, provides for three different methods of constructing oil aggregate surface, namely, road mix, traveling plant mix, and stationary plant mix.

Road mix and traveling plant mix methods are designated by the Bureau of Public Roads as Class B surfaces and stationary plant mix method as a Class F surface.

During the 1935 construction season 1¾ miles of road mix were laid on one project and 16¾ miles of stationary plant mix on three projects, one of which was 11⅓ miles long and now there is under contract for this year's construction 63 miles and in addition a WPA program of about 300 miles. The traveling plant mix method has not yet been used on our work.

*The Foundation.*—Oil aggregate surface course of 3 in. compacted thickness with 1½-in. crown is usually laid 20 ft. wide on old or new gravel bases having a width of 21 ft. If an old gravel road is to be used as a foundation it is reshaped and widened, if necessary, to provide 21 ft. of compacted metal of satisfactory thickness. Care must be used to eliminate waves and irregularities with blade or maintainer, to provide a base surface reasonably true to crown and grade. With a non-rigid surface on a gravel base, extra precautions must be taken to provide proper drainage facilities to take care of subsoil and surface water. In the construction of a new gravel base or conditioning of an old gravel base, tests are made by the Research and Testing Division to insure, in addition to properly graded aggregate, a sufficient amount of clay or binder to produce a stabilized foundation. Calcium chloride is used to assist stabilization in dry weather.

*Prime Coat.*—The prepared surface is then primed with bituminous material at the rate of approximately ⅓ gal. per square yard. The specifications permit the use of cut-back asphalt, slow curing oil, emulsified asphalt or tar. Slow curing oil was used as a prime on several projects, but did not work out as satisfactorily as medium curing cut-back asphalt or tar, due to the fact that the slow curing properties of the oil caused it to be picked up under traffic and hauling operations for a considerable length of time. One reason for the use of a prime coat is to seal the surface from moisture from below and any picking up or breaking of the prime coat destroys the seal.

*Mineral Aggregates.*—For both road mix and plant mix, the same aggregate specifications apply. Mineral aggregates may be natural sand gravel, crushed or uncrushed, slag, crushed mine rock, crushed stone, stamp sand, with finely divided mineral matter, supplied either

An abstract of a paper presented Feb. 16 at the Annual Conference on Highway Engineering at the University of Michigan.

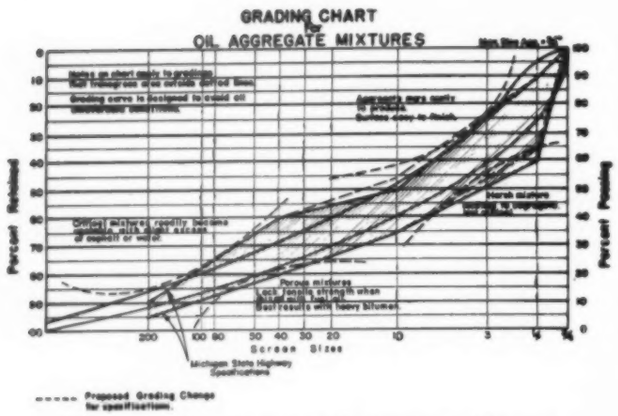



*Fig. 1—Grading Chart for Oil Aggregate Mixtures*

separately or in combination as may be necessary to conform to the following composition limits, by weight:

| | Per cent |
|---|---|
| Passing ¾-in. screen | 100 |
| Passing ½-in. screen | 60-90 |
| Passing 10-mesh sieve | 35-50 |
| Passing 40-mesh sieve | 20-40 |
| Passing 200-mesh sieve | 5-10 |

Clay balls or mud balls must not be more than 2 per cent.

Figure 1 shows grading limits of our specifications and proposed changes to better fit aggregate conditions and production methods and also produce denser mixtures. The material passing the ½-in. screen will be 65 to 90 per cent and material passing 10-mesh sieve will be 40 to 60 per cent. Aggregates conforming to the above requirements are available economically in most all sections of Michigan—principally gravel aggregates.

*Bituminous Materials.*—The oil required for this surface is a slow curing liquid asphaltic material. For road mix or traveling plant mix a medium viscosity oil known as SC-3A is specified while for stationary plant mix a high viscosity oil known as SC-4A is required.

The oil is a relatively small but important part of the mixture, since it is the bonding agent. The state highway department has adopted a specification to insure high quality for this important constituent of the mixture.

*Mixture Composition.*—Considerable study of experience and practice in other states and independent research work has been undertaken in the State Highway laboratory by W. S. Housel and Frank Olmstead under the direction of Research and Testing Engineer J. W. Kushing. Study of aggregates available in this state and their behavior with various fines in oil mixture has been given special attention. The water-asphalt preferential test indicates that some fillers have a greater affinity for water than for the oil. This property of fillers is, we believe, a more important consideration in the water resisting action and length of life of oil mixtures, than of hot asphalt mixtures, due to the nature of the bituminous materials. Some silica fillers, fine sands and silts have a greater affinity for water or are hydrophillic while most calcareous fillers, such as limestone dust, marl, sugar beet lime prefer the oil or are hydrophobic. Tests are made on available fillers in combination with the proposed aggregates to determine their suitability. The fineness and other characteristics of fillers are studied also to determine the amount of oil required.

The use of marl for filler on the East Jordan project was an innovation. Tests showed this marl to be mostly calcium carbonate, though somewhat finer than commercial limestone dust. Allowance for this fineness was made in the surface area factor, using 300 instead of 250 as the factor for the material passing 200 mesh and consequently a little more oil. The problem of handling and drying the marl is discussed later.

The specifications require the amount of oil to be between 4 per cent and 6 per cent by weight of the total mixture. The exact amount of oil required for a particular aggregate and filler is determined by the Research and Testing Division using the surface area method, from which the chart shown in Fig. 2 was developed. The per cent of 200 mesh material is usually required to be between 7 and 8 per cent.

The amount of moisture in the aggregate was required to be below 2 per cent but since experience has shown that better results are obtained by keeping the moisture below 1 per cent, the specifications are being so changed.

After the mix has been determined the plant inspector makes frequent analyses of the aggregate and checks results by several extractions each day during operations.

*Stationary Plant Mix Method.*—This method, although somewhat higher in first cost, results in a more uniform mixture due to facilities for proportioning aggregate, control of moisture content and amount of oil. The essential parts of a plant are a drier capable of reducing the moisture content of the aggregate below 1 per cent with a temperature of less than 250° F. at time of mixing, a screen and bins to divide the aggregate into fine and coarse sizes, a weigh box to accurately weigh each size of aggregate and the filler, bucket and

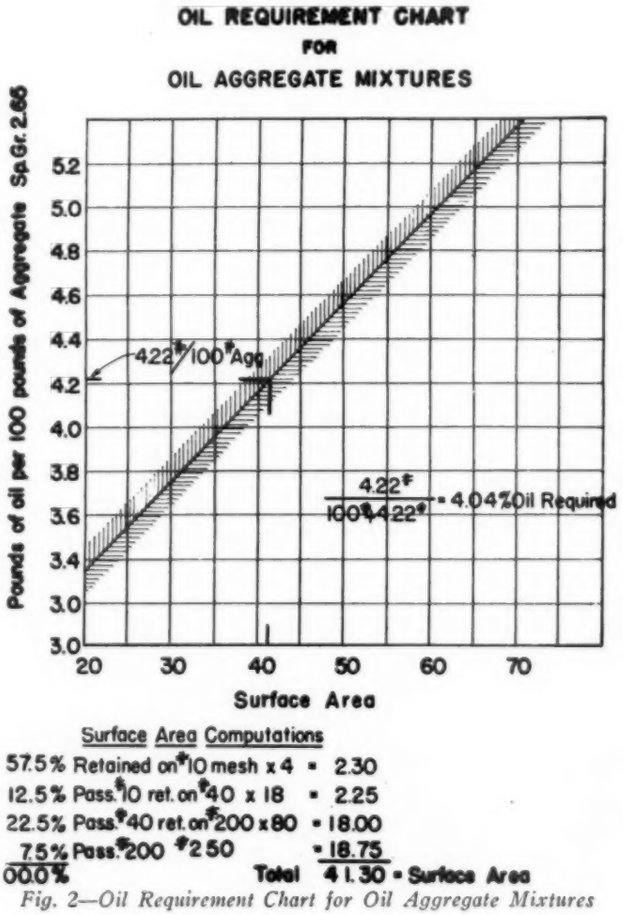



*Fig. 2—Oil Requirement Chart for Oil Aggregate Mixtures*

*Fig. 4—Removing Moisture from Marl by Heating Over Large Corrugated Pipe*

scale to give close control of the amount of oil and a twin pug mill mixer.

On the three projects of this type built during 1935, at Bay City, East Jordan and Holly, standard hot mix asphalt plants were used, because the contractors had them available. These plants were equipped with internal oil fired driers, two screens and bins, weighing apparatus for aggregates, dust and oil, and twin pug mixers.

*Plant Equipment and Operation.*—The 11-mile East Jordan contract completed last fall had a 20 ft. wide oil aggregate surface of 3 in. compressed thickness, laid on a primed new 21 ft. gravel base. Sand and gravel aggregate for the surface mixture was produced by a portable gravel plant in a deposit near the project. A portable hot mix asphalt plant was set up on a railroad siding nearby. This plant had a large drier and a 1-ton twin pug mixer (Fig. 3).

A deposit of marl on high land with practically no overburden, was found within a mile of the plant site. Since marl has a high moisture content, sometimes 50 per cent, the problem of drying presented itself. Ordinary drying methods cause it to cake and become lumpy. After being hauled to the plant site it was piled over large diameter corrugated pipe with fire built inside (Fig. 4). This removed a considerable portion of the moisture. The marl was then fed into the drier with the aggregate. Passing through the drier it was pulverized and drying completed and passed through the screen into the bin with the sand. In order to prevent the fines from being lost by the fan induced draft, a dust collector gathered the fines from the exhaust and deposited them into the foot of the elevator at the discharge end of the drier. To provide the proper amount of 200-mesh material, the marl was fed on a separate elevator. By trial, the number of buckets of marl for the full complement of aggregate buckets was determined. Frequent analysis of the aggregates by the inspector enabled him to check the amount of 200-mesh material present in the sand and to vary the amount of marl fed to give the desired result in the mixture within reasonable limits.

The aggregate was divided into two bins by a No. 6 mesh vibrating screen. Although the aggregates produced by the gravel plant were uniformly within specication limits, there was occasional segregation in stock piles, but weighing the required amount of coarse and fine aggregate for each batch produced a uniform mixture with the same oil content. Frequent extractions of the mixture were made by the inspector to check the results.

With the type of drier on this hot mix plant it was found necessary to heat the aggregates to a temperature of 220° to 250° F. in order to keep the moisture content below 1 per cent. Since there was usually about a 20° drop in temperature by the time the aggregate reached the mixer and with an oil temperature of 160° to 175° F., the resultant mix temperature usually ran between 180° and 225° F. The maximum temperature at time of mixing permitted by the specifications is 250° F. While some of the oil volatiles are lost in mixing at above temperatures, workability was not destroyed

*Fig. 5—Oil Aggregate Plant*

*Fig. 7—Scarifying and Reshaping with Grader Pulled by Tractor*

as is evidenced by scarifying experiments referred to later.

Mixing time was 10 seconds dry and 35 seconds after the oil was added, making a total of 45 seconds. This mixing time under the conditions, produced a thoroughly coated and black looking mixture.

Similar hot mix asphalt plants but of a smaller capacity were used on the Bay City Park and Holly projects. Aggregates from commercial gravel plants with limestone dust for fines were used. The limestone dust was weighed separately into each batch as in hot mix practice.

*Observations on Plant Equipment.*—Since the oil aggregate type of surface is designed to meet the demand for a low cost road, portability and simplicity of the manufacturing plant, consistent with reasonably uniform mixture results, and the use of available aggregates, are important considerations. Plants that can be transported in units on trailers over the highways to aggregate deposits, away from railroads, are desirable. Some such plants are now on the market and others are in the process of design. The essential units, in addition to the equipment for aggregate production are a portable drier, a two compartment bin with screen for separating sand and coarse aggregate with necessary elevator and a mixing unit with weighing accessories for aggregate, dust and oil. Power can be provided separately or with each unit (Fig. 5).

The design of driers used on hot mix plants, while in successful use for many years for this type of construction, seems somewhat inefficient for oil aggregate construction. For hot mixes, aggregates must be thoroughly dried and heated to a temperature of about 375° F. but in oil aggregate construction, the aggregates as a rule need only be surface dry and a moisture content up to 1 per cent will not prevent good results. Further, a high temperature for the aggregates is not necessary or even desirable. Drier design, making greater use of the principle of evaporation and consequent drying and cooling with a large volume of air, would, no doubt, produce greater efficiency and economy.

The mixing unit, found by general experience to be necessary for good results with oil mixture containing a large amount of fine material, is a pug mill mixer. Generally mixing units have been of the batch type.

Continuous pug mixer units with metered oil pumps have been in use, mostly with the traveling plant method. Such units have large capacity for the size of the plant and are readily portable. If they are designed to insure an accurate and consistent mixture they should be a very economical unit used as a stationary plant.

The various units of the plant equipment should, of course, be coordinated with each other and with the capacity of the spreading equipment and aggregate production unit. Generally 40 to 60 tons of mixture per hour has been found to be satisfactory and economical capacity.

*Fig. 6—Rolling Immediately Behind the Spreader*

*Spreading Equipment.*—On all the plant mix projects laid last season Admun mechanical spreaders were used. These machines spread and strike off the mixture up to 10 foot widths. The machine is carried on two wide rollers which ride on the finished surface and on two wheels on extension ahead riding on the base. The strike off being under the hopper near the rear rolls enables the machine to reduce inequalities in the gravel base by a ratio of approximately 4 to 1. Best results were obtained by spreading the oil aggregate mixture in two or more layers to provide a good riding surface.

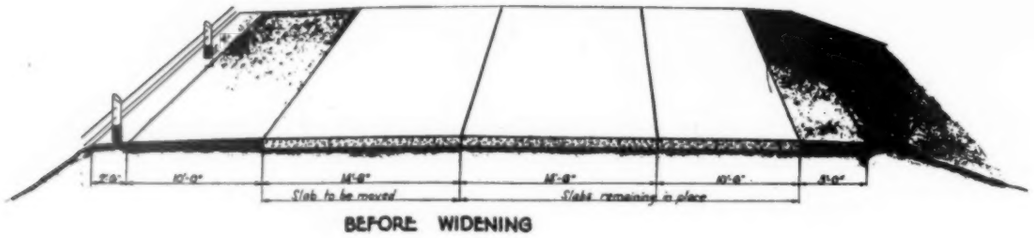
Another type of mechanical spreader, known as the Jaeger black top spreader has been used in other states and will probably be used on some of our projects for this year's construction. This spreader is similar in action to the Admun, except that it is carried by wheels and runners on the base. Still another type the Blaw-Knox finish spreader spreads the material from a hopper.

Rolling with a tandem roller weighing 8 tons, during warm weather was deferred until late in the afternoon and sometimes the following day, though when the weather was cool, rolling could follow immediately behind the spreader (Fig 6). Straight rolling, once over, was found to be the best practice as excessive rolling while the mixture was warm or fresh caused checking and shoving. In the summer, a second or third rolling on succeeding days was found to be beneficial.

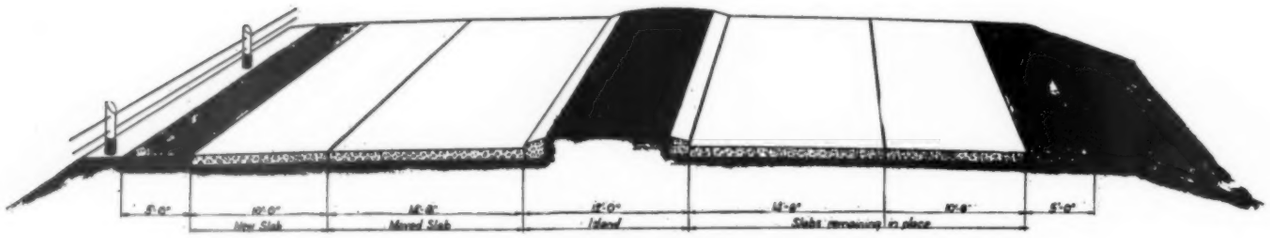
Light traffic was allowed to pass over the freshly laid material to assist in compaction. During warm weather traffic marks the surface for several days but light blading or dragging with a maintainer and additional rolling keep the surface in a smooth condition until crust is formed on the surface. During cool weather, light traffic marks the surface only slightly and irons out the marks in a short time. On the East Jordan and Holly projects, surface was laid in all types of weather and completed in the last part of November. No difficulties were encountered in laying oil aggregate by the plant mix method in temperatures approaching freezing. It is quite probable, however, that some aggregate combinations which are on the border line in the water-asphalt preferential test would require greater care in handling.

*Scarifying and Reshaping.*—Several interesting experiments were made. A considerable stretch of surface on the East Jordan project was scarified and reshaped. A large grader with scarifier attachment pulled by a tractor (Fig 7) was used to break the surface to a depth of about 1½ in. or about half the total surface depth. This was done in the latter part of October when the temperature was around 60° F. on a stretch of surface that had been laid and under traffic for over a month. Since the teeth on the scarifier were about 4 in. apart and the comparative coolness of the air made the oil aggregate rather stiff, the mixture did not break up uniformly. A device made up of railroad spikes set 2 in. apart was attached to the front blades of a maintainer. This was pulled by a truck and followed the larger scarifier and broke up the surface uniformly to a depth of about 1½ in. The mixture, so loosened, followed through the blades of the maintainer and was struck off by the rear blade leaving a smooth surface free from waves due to the long wheel base of the maintainer (Fig. 8). On part of this stretch new mixture was fed through the maintainer at the rate of about 50 tons to the mile to blend with the old. Rolling followed the reshaping. This outfit scarified and reshaped the surface at the rate of a mile a day at very low cost. This experiment demonstrated the fact that even though there was probably some loss of volatiles at the comparatively high temperature of mixing, workability was not sacrificed. It is reasonable to assume that if the mixture could be scarified in the cool fall temperatures, it should be more readily worked in the hot weather of next summer.

*Fig. 8—Section South of East Jordan, Scarified and Reshaped Surface*




BEFORE WIDENING




AFTER WIDENING

*Fig. 1—Cross-Sections of Present and Proposed Roadway*

# METHOD OF MOVING 14½-FT. SLABS ON BRUNSWICK TURNPIKE

By SIGVALD JOHANNESSON

*Designing Engineer,*
*New Jersey State Highway Department*

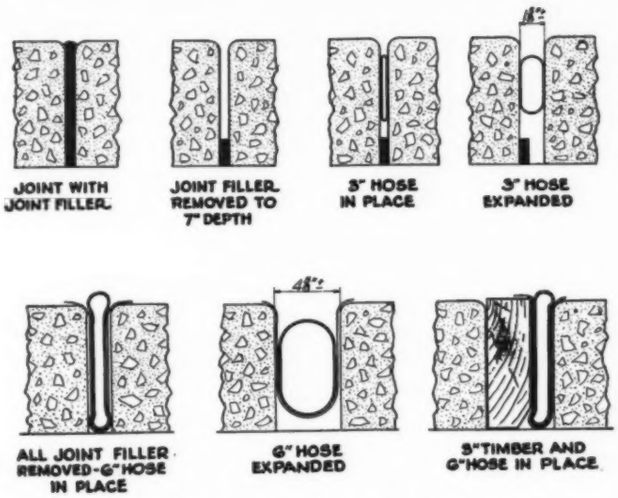
[During 1935 the State Highway Department of New Jersey undertook the unusual operation of moving latterally 7 miles of a 14½ ft. lane of concrete on the Brunswick Turnpike. The slab was moved a distance of 12 ft. so as to provide a center island of that width and the construction of an additional 10 ft. lane of concrete along the moved slab. It also permits the construction, badly needed, of adequate underdrawings in the island area. A brief account of this work was given in December, 1935, issue of ROADS AND STREETS. The accompanying description of the slab moving method is taken from a paper presented by Sigvald Johannesson at the recent convention of the Association of Highway Officials of the North Atlantic.—EDITOR.]

WHEN the possibility of moving the pavement to a new location was first discussed, it was generally assumed that the moving would be carried out by means of hydraulic jacks, but there presented itself immediately the difficulty of applying the jacks at the beginning of the move. For practical purposes, there appeared to be only one point of attack, and that is the narrow opening in the concrete surface forming the longitudinal joint of the pavement. If this opening could be widened enough to apply the jacks, the remainder of the problem of moving appeared fairly simple.

A number of methods for widening the joint opening were suggested and experiments were carried out at Fernwood, N. J., on an existing 2-lane concrete pavement. The most promising method tried out involved the use of an ordinary linen fire hose inserted in the joint opening and subjected to hydraulic pressure. Subsequently, air pressure was used instead of water pressure with satisfactory results. Originally, it was the intention to use the hose only to open the joint wide enough to permit the use of jacks, but the result of the experiments was so successful that it was decided to use the hose method for the complete moving of the slabs. Subsequently, the method was tried out on a concrete slab on the Brunswick Turnpike, and as the result of this experiment also was satisfactory, plans were made to move a 7-mile stretch of the pavement on the Brunswick Turnpike by this method.

Cross-sections of the present and the proposed roadways are shown in Fig. 1. The present pavement consists of two slabs, each of which is 14 ft. 6 in. wide, and a third slab, 10 ft. 6 in. wide. The slabs have a uniform thickness of 9 in. and are reinforced 2 in. from the top. The longitudinal joints are plain, vertical, undoweled and filled with pre-moulded mastic joint filler. The transverse joints occur normally at intervals of 34 ft. 4 in. and the adjacent slabs are connected by means of six dowels across the transverse joint.

*The First Operations.*—After the shoulder has been excavated to slightly below the subgrade, the first operation in the work of moving the slabs is to divide the pavement in sections, having an average length of about


JOINT WITH JOINT FILLER
JOINT FILLER REMOVED TO 7" DEPTH
3" HOSE IN PLACE
3" HOSE EXPANDED
ALL JOINT FILLER REMOVED-6" HOSE IN PLACE
6" HOSE EXPANDED
3"TIMBER AND 6"HOSE IN PLACE

*First Operations in Moving Slab*

450 ft., and to separate such a section from the remainder of the pavement by cutting the dowels and removing about 4 in. of the slab at the transverse joints at the ends of the section. Next, the joint filler is removed to a depth of 7 in. by means of a special plough, devised for the purpose. The plough iron consists of a flat steel plate, ⅜ in. thick, bolted to two steel angles. The plough is propelled by means of a 10-ton roller and removes in its forward travel the joint filler, which comes out of the joint in the form of a spiral ribbon. The ploughing is repeated to remove any joint filler that may remain after the first cut, and finally, any small pieces of filler that may still be found are removed by hand. It is necessary to make the cleaning out of the joint quite thorough, because the joint opening is so narrow that all available space is needed to carry out the next step, which is the insertion of the hose.

*3-In. Hose Use for Initial Move.*—The hose used for the initial move is a common linen fire hose, having a diameter of 3 in. When collapsed this hose has a width about 5 in. and thickness of a little more than 3/16 in. The hose is in 100 ft. lengths with standard female couplings, into which are screwed 3 in. by ¾ in. bushings and ¾ in. nipples, and the hose lengths are connected with short pieces of ¾ in. rubber hose. Before the hose is inserted it is soaked in water to make it reasonably air-tight, covered with graphite to make it slip into the joint more easily, and ironed flat with a light hand roller. It is then inserted in the joint opening and eased down by hand until the top of the flattened hose is about flush with the top of the concrete pavement, except at the couplings, which are allowed to extend above the pavement surface. At each intermediate coupling, connections are made to the compressor plant by means of 1-in. rubber hose. Just before the air pressure is applied, a small amount of water is poured into the hose and blown through it to swell the inside linen fibers and make the hose as air-tight as possible. After this is done, compressed air is introduced in the hose and at a pressure of from 20 to 30 lb. per square inch, and slab starts to move. As the hose starts to swell, the contact surface is decreased and the air pressure is increased and under a final air pressure of from 80 to 100 lb., the slab will have moved so that the width of the opening is increased to about 2 in.

*6-In. Hose Used for Subsequent Moves.*—It would, of course, be possible to continue with the use of the 3 in. hose, but the actual move of the slab would be only about 1 in. per inflation, and for greater speed, a 6 in. hose is used for the subsequent moves.

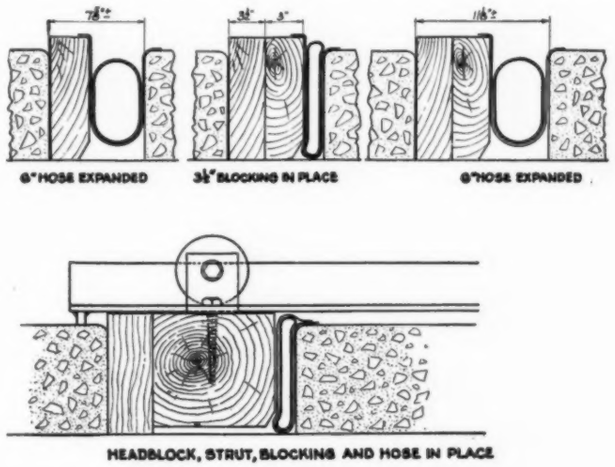
The 6 in. hose is rubber lined, cotton jacketed hose of commercial type. It is used in lengths of 31 ft. 2 in., with special couplings, devised for the purpose.

The coupling is made by inserting a ¾ in. nipple at the end of the flattened hose. The nipple and the end of the hose is vulcanized by special methods and a steel clamp, held in place by bolts and machine screws, is applied at the outside of the vulcanized end of the hose. Connections between the hose lengths are made by means of short lengths of ¾ in. rubber hose attached to the nipples of the 6 in. hose.

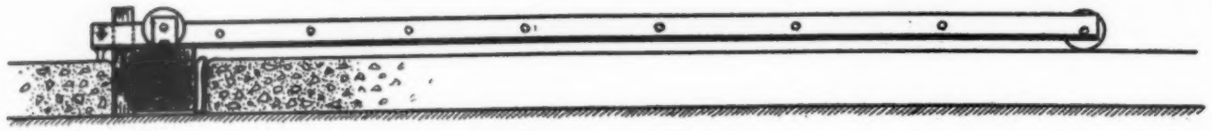
After the 3 in. hose has been removed from the joint opening, the joint filler remaining in the opening is removed and the 6 in. hose is inserted, one length of hose being used for each slab length. Connections to the compressor plant are made by means of 1 in. rubber hose at four points. At the end of each hose length is a valve, through which the air in the hose may be exhausted into the open air.

*Timber Blocking and Its Use.*—When all connections are made, compressed air is introduced into the hose which gradually expands to about 5 in., moving the slab laterally for a distance of about 3 in. The air is then exhausted through the valves above described, a 3 in. plank is inserted as backing for the hose and the hose is again inflated, increasing the width of the opening to about 11½ in. This process is repeated once more, producing an opening having a width of about 15 in. The timber and blocking and hose is then removed from the opening and a 10 in. by 10 in. timber, which is to be used for the remainder of the operation, is inserted in the opening, and the hose is replaced, wrapped in canvas to protect it from abrasion. For each subsequent move, blocking is placed between the timber and the face of the stationary slab at four points per slab, the blocking being spaced about 9 ft. centers.

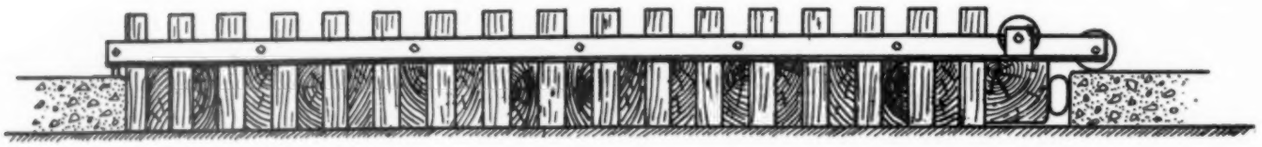
The blocking consists of 3½ in. by 9½ in. by 18 in. yellow pine timbers, held in place by means of frames consisting of two 4 in. by 4 in. by ⅜ in. angles connected at intervals with ¾ in. diameter bolts. The blocks are placed alternately vertically between the angles and horizontally below the angles. The 10 in. by 10 in. timbers are supported by rollers on the horizontal flange of the angles in order to make it possible to move them forward with as little friction as possible. After the 10 in. by 10 in. timbers and steel frames are placed in position, the work of moving the slab becomes a matter of routine. The hose is inflated, making the




*Subsequent Operations in Moving Slab*



*Headblock, Hose Blocking and Strut Ready to Start*



*The Completed Move*

slab move laterally a distance of 3½ in.; the hose is deflated; the timbers are moved forward by means of crow-bars; a block is inserted and the hose is again inflated. The cycle of operation generally takes a little less than 5 minutes, 1½ minutes being used for inflation.

When the work has proceeded so that less than 3½ in. remain to complete the move of 12 ft., measurements are taken at each frame to determine the exact amount of movement required and blocks of the proper width are inserted instead of the standard 3½ in. blocks. Generally, the difference in width of this last block is less than ¾ in. from the one end to the other of the section.

After the move has been completed, the three men, who perform all the necessary work for each slab length, load the equipment used for that slab on a hand truck and place it in its proper position on the next section. The equipment for a 450 ft. section weighs about 60 tons, and each truck takes two trips to complete the moving to the next section. A little more than one hour is spent in moving from the one section to the other.

The compressor equipment consists of two compressors, each having a capacity of 210 cubic feet of free air per minute and two air receivers, having a capacity of 144 cubic feet each. The compressors and receivers are moved in a train, drawn by a tractor.

After the movement of the slabs has been completed, they are raised to their proper elevation and firmly bedded on their own subgrade by means of a mud jacking operation. Eight holes, uniformly spaced, are drilled through each slab, and a mixture of 1 part of cement and 6 parts of top soil is pumped through these holes until the pavement has attained its proper elevation. Investigations have shown that the grouting mixture is distributed so as to provide complete bearing for the full area of the slab.

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## To Encourage New Uses of Cotton in Highway Construction

Secretary of Agriculture, Henry A. Wallace, has approved the use of funds for the purpose of stimulating field tests of new uses of cotton in highway construction. The project provides for the diversion of manufactured cotton fabric for use as a reinforcement membrane in bituminous surface treated highways and for cotton mats for use in curing concrete highways. These materials will be furnished upon request to state highway departments so that they may be tested in widespread use under all climatic conditions. If the results of these tests are as favorable as certain preliminary trials along these lines have indicated, these new fields of use would require large quantities of cotton in the future.

This project involves an allocation of $1,300,000 which is made available by Section 32, Public No. 320, which appropriates 30 per cent of the customs receipts to the Secretary of Agriculture for certain purposes. Under the program as approved by the Secretary of Agriculture, cotton fabric for bituminous surfaced roads will be provided for a maximum of 1,000 miles of this type of road. An aggregate of approximately 80,000 cotton mats for curing concrete in highway construction will be made available for an average of at least three projects in each state.

The project which has the approval of the Bureau of Public Roads will be administered jointly by the Bureau of Public Roads and the Agricultural Adjustment Administration.

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## State Highway Department of Kentucky Reorganized

Under a bill passed last month by the General Assembly of Kentucky the entire setup of the state highway department is changed. The bill provides that the department shall be headed by a Commission of Highways who has sole charge of the administration of the department. The technical advisor to the Commissioner of Highways is the State Highway Engineer, who must be a civil engineer having at least four years' executive engineering experience after receiving the C. E. degree from an accredited university or college.

The department is divided for administrative convenience into the following divisions:

Division of Construction
Division of Records
Division of Equipment
Division of Maintenance
Division of Highway Patrol.

Each division performs such duties as may be assigned by the Commissioner of Highways, and is headed by a director, who acts under the direction and supervision of the Commissioner.

An advisory State Highway Commission is also created, composed of nine members; a member being selected from each of the nine Congressional Districts. These nine Commissioners have no administrative authority but serve in an advisory capacity to the Commissioner of Highways.

*Fig. 1. — Coal Vein and Scoria Deposits Both Shown at Left of Highway.*

# HIGHWAY PROBLEMS DUE TO LIGNITE DEPOSITS IN NORTH DAKOTA

**By ARTHUR C. SELKE, Ph.D.**

*Professor of Geography, State Teachers College, Dickinson, N. Dak.*

MANY of the unique problems which arise in Southwestern North Dakota are due to the presence of large amounts of lignite coal. When a lignite vein appears at the surface, it makes a rather poor road surface because it is too soft. This is remedied by grading and by the use of other surfacing materials.

Most of the problems due to coal are occasioned by past or present fires. Coal fires may have started from human or other causes. Prairie fires set by man have, no doubt, ignited much lignite in the past. Exposed veins were lit by the conflagrations and slowly burned along the stratum of coal. Nowadays cigaret butts, engine sparks, and picnic fires are a few of many causes. Broken bottle glass may be of such form that the sun's rays so focus upon coal or other fuel nearby as to ignite the lignite. Among causes other than human which cause these subterranean fires, the chief one is undoubtedly lightning. In western North Dakota lightning often does considerable damage during dry seasons. Sparks from rolling stones or the hoofs of animals may conceivably also cause coal to burn. And the coal itself is subject to spontaneous combustion if properly exposed to the action of oxygen.

If a coal vein, exposed near a highway (see Fig. 2) catches fire it follows the stratum and works its way under the highway (see Fig. 2). The highway will then settle over the burning lignite vein. Such situations occur occasionally especially along the coal-laden roads through the North Dakota Badlands. Conditions such as these endanger the thoroughfares and highway engineers in this section of the state are constantly on the alert for these phenomena.

It is difficult to extinguish such a lignite incandescence. Mere dousing by water or even by continued rain have little effect. But little of the water gets near the embers and even this is evaporated. By digging a trench in the fuel ahead of the smouldering flame, the further spread of the conflagration can be prevented. In the meantime, engineers must re-route the highway on a more stable roadbed.

Fortunately, such "burning coal mines" also have a beneficial value to highway builders; for in the past there have been formed deposits of natural brick, out of the earth which was exposed to the heat of the coal embers. These deposits of slag and clinker from fires of the days of yore are irregular, but nevertheless quite abundant in the lignite areas of the Great Plains. Since the "scoria," as this natural brick is called, is found chiefly on slopes, roads ordinarily cannot be routed over it. But scoria is good for road surfacing and many deposits of it are found very close to highways. Figure 1 shows deposits of both coal and scoria adjoining a road in the Badlands.

In this region where gravel is scarce, scoria is frequently substituted for it. In some respects the natural brick is inferior to gravel. Sometimes it is hard on tires, particularly just after it has been put on the roads. Scoria (or slag and clinker) also has a tendency to grind up and blow away. Scoria does not last as long as gravel, and it may become slippery in wet weather unless renewed frequently.

However, scoria has many good points. Loose scoria is not as dangerous to drive upon as loose gravel. The pieces of this natural brick are rough like crushed rock, and when they are worked into the roadbed they make an excellent foundation. The color, a salmon pink, is very different from the drab highway surfacing commonly

*Fig. 2—Diagram Showing a Vein of Coal Below a Highway with Coal Exposure on the Slope to the Left. Such Formations are Common in Southwestern North Dakota.*

*Fig. 3—Slump Occasioned by Burning Coal "Mine" Under Highway.*

*Fig. 4—Typical Badland Scenery of North Dakota, Showing Gulleying and Difficulty of Road Engineering*

used. Through the Badlands scoria has made many beautifully scenic pink trails through varied-colored hills. Finally, in a region deficient in gravel deposits, the abundance of scoria deposits close to highways afford good, cheap surfacing which is preferred by many to gravel. Even the tendency to blow away can be reduced by mixing clay with the scoria. It will, therefore, continue to be used to a great extent, either alone or mixed with gravel, on many of the turnpikes of western North Dakota.

While many of the highway problems of southwestern North Dakota are similar to those farther east, the road builder or highway supervisor finds many distinctive problems in the coal area. He is compelled to adjust himself to problems, perhaps even surprises, which do not exist in other regions. The topography and road materials are in part different and he is obliged to learn about these and to take advantage of them wherever possible.

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## A. S. T. M. Committee on Road and Paving Material

As the result of a large number of meetings of American Society for Testing Materials standing committees, held in Pittsburgh during Committee Week, March 2-6, many new standard specifications and methods of test are to be recommended to the Society. In all there were about 150 meetings, including main standing committees, their sections and subcommittees. The total registered attendance for the group meetings was about 625, exceeding that of any previous year. The work of the Committee on Road and Paving Materials at this meeting was as follows:

In 1935 ASTM Committee D-4 on Road and Paving Materials, in cooperating with Committee D-8 on Waterproofing and Roofing Materials, recommended that the tables designated as Groups 0 and 1 in the Standard Abridged Volume Correction Table for Petroleum Oils (D 206-34) be tentatively approved as a Volume Correction Table for Asphaltic Products since these tables were being commonly used in the asphalt industry. The committees are now planning to present to the Society a recommendation for approval as standard of these two groups of tables as applicable to asphaltic products. Action was taken by Committee D-4 to recommend to the Society that the Tentative Method of Test for Residue of Specified Penetration (D 243-35 T) be adopted as standard.

The committee has been studying the test methods and apparatus for testing bituminous road materials which are under its jurisdiction. A review of the Tentative Method of Test for Separation of Liquid Asphaltic Products (D 402-34 T) has shown that the condenser at present specified for use in the distillation assembly is in need of modification so far as the dimensional requirements are concerned so as to make it more practicable to manufacture this piece of test apparatus. A more complete description of the type of vent holes that it is permissible to use in the oven of the Standard Method of Test for Loss on Heating of Oils and Asphaltic Compounds (D 6-33) will be recommended for immediate adoption in this standard method.

Committee D-4 also received for consideration the revised method of test for softening point by ring-and-ball method which has been prepared by a special subcommittee on this subject of ASTM Committee E-1 on Methods of Testing. This method was presented as a revision of and is intended to replace the present Standard Method of Test for Softening Point of Bituminous Materials (Ring-and-Ball Method) (D 36-26) which was prepared originally by Committee D-4. The scope of the revised method has been enlarged so that the test will now be applicable to rosins and resins, both synthetic and natural, as well as to asphalts, tars, pitches and similar bituminous materials. In considering the revised test procedure, Committee D-4 is planning to consider the feasibility of discontinuing the present standard method under its jurisdiction.

In view of the interest that is being shown in methods for the measurement of viscosity the committee has undertaken a study of several types of apparatus for determining absolute viscosity. This work will include a study of apparatus and methods of measuring absolute viscosity for the complete range of bituminous materials.

The committee is giving consideration to the endorsement of the Simplified Practice Recommendation for Coarse Aggregates (Crushed Stone, Gravel and Slag). It is planned to review the existing specifications for aggregates under the jurisdiction of the committee looking toward the modification where necessary of such specifications so that they will be in conformity with this recommended practice.

The officers of Committee D-4 are: Chairman—M. H. Ulman, Assistant Engineer of Materials, Pennsylvania State Highway Department; Secretary—Prevost Hubbard, Chemical Engineer, The Asphalt Institute.

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## Boye of Socony-Vacuum Again Heads Asphalt Men

At their annual meeting the Board of Directors for the Asphalt Institute, representing three-fourths of the asphalt producing industry of the United States and Canada, re-elected B. L. Boye, of Socony-Vacuum, president for the fiscal year beginning April 1st.

At the same time it was announced that the Allied Materials Corporation of Oklahoma City had been elected to membership with C. W. Barbour as its representative in the Institute directorate. Tonnage figures reported indicated that the asphalt industry in 1935 had enjoyed 10 per cent sales increase over the preceding year.

Other officers elected at the annual meeting were J. A. Blood (Standard Oil Company of California), vice-president; Leroy M. Law (Shell Petroleum Corp.), vice-president; T. M. Martin (Lion Oil Refining Co.), vice-president; A. M. Maxwell (Standard Oil of Ohio), vice-president; C. W. Bayliss (Barber Asphalt Co.), chairman of Executive Committee; Herbert Spencer (Standard Oil of New Jersey), treasurer; J. J. Gartland (Texas Co.), secretary; J. S. Helm of the Standard Oil Company of New Jersey succeeded W. W. McFarland of the Warner-Quinlan Co. as a member of the Executive Committee and J. E. Pennypacker continues as managing director of the Asphalt Institute.

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*Grace and Fitness of Design Characterize the Soucook River Bridge.*

# A THREE-SPAN RIGID FRAME BRIDGE IN NEW HAMPSHIRE

THE bridge carrying Rocky Pond Road (State Route 106) over the Soucook River near the town of Loudon in Merrimack County, New Hampshire, is a three-span, rigid frame structure with a total length of 143 ft. 6 in. The center span is 56 ft. and the two end spans 42 ft. each, measured between center lines of piers. It was built in the latter part of 1934. The height from bottom of center pier footings to roadway surface is about 29 ft.

The improvement involves a straightening of the road, and the location of the bridge at a point some 250 ft. downstream from the old crossing. The roadway is 24 ft. wide between curbs, and the overall width is 28 ft. 10 in. There is no sidewalk. A one per cent grade extends the entire length of bridge and approach fills.

## Design

Specifications call for 3000 lb. concrete with a minimum cement factor of 1.61 for the entire structure except the footings, for which 2000 lb. concrete with a minimum cement factor of 1.30 is required. All corners were cast square and trimmed round with carborundum stone.

There are 3 structural arch ribs, each 1 ft. 6 in. thick, spaced 9 ft. 6 in. apart on centers. Column widths are the same as the ribs, except for an ornamental extension on outside columns. End columns are of uniform cross section, with a dimension of 3 ft. 6 in. in the longitudinal direction of the bridge, while center columns taper from 3 ft. 6 in. at the springing line to 2 ft. 3¼ in. at footing. All columns are keyed to the footing blocks.

The arches are 3-centered, the radii being 115 ft. 2 in. for the main portion of each span, 7 ft. 5¾ in. for the up-grade end, and 7 ft. 8¼ in. for the down-grade end. The ribs are joined by transverse arches of 4 ft. radius above the columns, and by shallow beams at the main arch crowns. A 4 ft. 2 in. cantilever on each side carries handrail, curb, and a portion of the roadway.

The roadway slab is 9 in. thick, and is entirely covered with 1 in. asphalt plank.

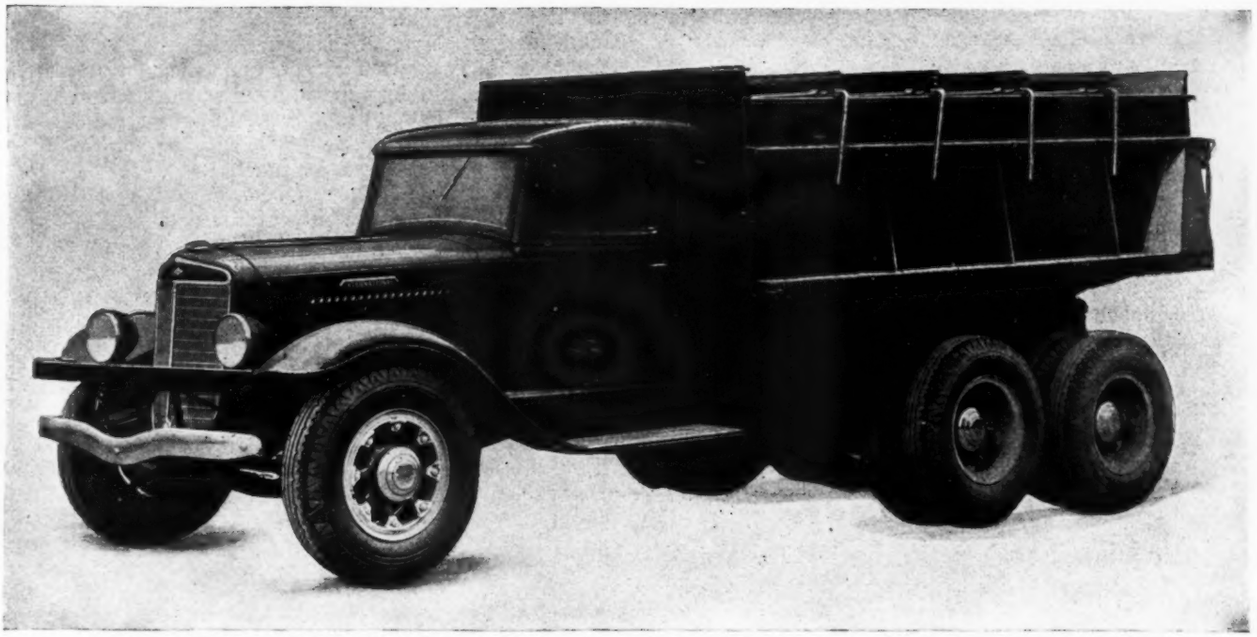
Each footing measures 8 ft.x28 ft.x3 ft. thick. End footings are supported on 2 outer rows of 9 piles each, and an inner row of 3 piles. Center footings are supported on 27 piles each, in 3 rows. Piles were driven to coarse sand, or coarse sand and gravel, which had been previously tested and found satisfactory. The row of piles at each end of the bridge and the two outer rows for each center footing are battered 1 in 4.

There are no abutment walls. The end bents are completely buried in the approach fills, which extend under the bridge with their toes about at the center bents. No rip rap was used on the slopes, since the river is sluggish at this point and rises only slightly over the toe of the fills. Should erosion start later on rip rap will be added.

Handrails are of reinforced concrete of pleasing design. Approach guards consist of two ¾ in. wire cables at each side, end-anchored to the bridge rail.

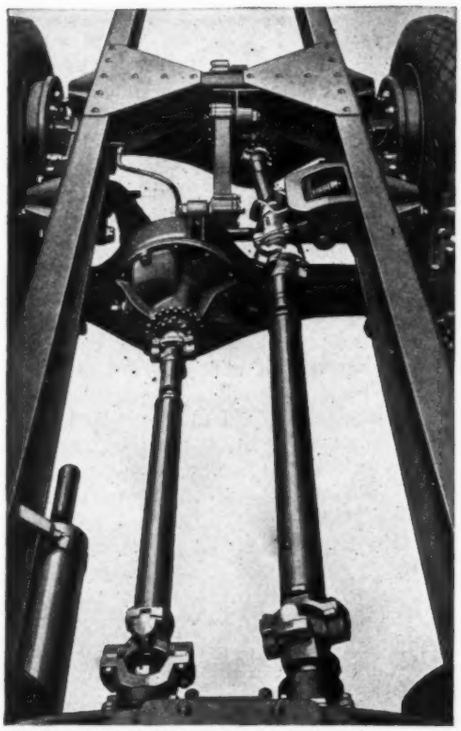
## Cost

The cost of the Soucook River bridge to the State of New Hampshire was $15,133.80 exclusive of engineer-



International 3½ to 7-ton Model C-55-F dual-drive six-wheel truck with 9 cubic yard batch body. International Six-Wheelers (dual-drive and trailing axles) range in size from 1½ to 7 tons; wheelbase lengths from 168 to 224 inches, permitting a wide variety of bodies up to 18 feet in length.

# Solve Your Heavy-Hauling Problems *with the* New Dual-Drive International Six-Wheelers



The International dual-drive six-wheel trucks have the power delivered individually to each rear axle by means of a power divider. The rear axle has a double propeller shaft supported by a patented oscillating bearing support which allows maximum vertical axle travel.

● These new Internationals, with maximum carrying capacities of 14,500 and 23,000 pounds, offer many exclusive advantages to the contractor with unusually heavy loads to haul. They enable you to make full use of the rated carrying capacity without damage to truck or highway. Their positive drive on four wheels (eight tires), through two driving axles, assures exceptional traction in mud and sand, as well as on rocky roads and hard highways. The use of an exclusive third differential unit — incorporating a power divider and over-drive and under-drive — triples the number of speeds provided in the regular transmission.

The driving mechanism is designed so that all four driving wheels are free to follow irregularities in the road-bed and to climb over all ordinary obstructions. Gaining this freedom and at the same time retaining perfect alignment of all parts is considered an outstanding achievement in motor truck engineering.

We suggest that you call on the nearest International branch or dealer and ask for detailed information on these new dual-drive, six-wheel trucks. The line also includes six-wheel trucks with trailing axles, and a full range of four-wheel trucks in sizes for all kinds of work.

**INTERNATIONAL HARVESTER COMPANY**
(INCORPORATED)
606 So. Michigan Ave. Chicago, Illinois

# INTERNATIONAL TRUCKS

ing and other overhead. Details as given on the final estimate were as follows:

| | | | | | |
|---|---|---|---|---|---|
| Structure excavation (uncl.) | 300 | cu. yd. | @$ | 2.50 | $ 750.00 |
| Unt. timber bearing piles. | 1,504 | lin. ft. | @ | .60 | 902.40 |
| Pile cut-offs | 867.5 | lin. ft. | @ | .11 | 95.43 |
| Concrete Class "A" | 323 | cu. yd. | @ | 22.00 | 7,106.00 |
| Concrete Class "C" | 98.6 | cu. yd. | @ | 14.00 | 1,380.40 |
| Reinforcing steel | 75,255 | lb. | @ | .0435 | 3,274.07 |
| Concrete bridge rail | 287 | lin. ft. | @ | 2.50 | 717.50 |
| Special anchorages | 4 | each | @ | 10.00 | 40.00 |
| Asphalt bridge plank | 3,472 | sq. ft. | @ | .25 | 868.00 |
| Total | | | | | $15,133.80 |

This is about $4.40 per sq. ft. of roadway surface, and about $3.70 per sq. ft. of total horizontal area.

The bridge was built under the direction of J. W. Childs, Bridge Engineer, H. E. Langley, Assistant Bridge Engineer, New Hampshire State Highway Department. Lane Construction Corporation of Meriden, Connecticut, was low bidder.

▼

## Principles for Securing Most Efficient Use of Engineering Student's Time

By WILLIAM OTIS HOTCHKISS

*President, Rensselaer Polytechnic Institute*

At the risk of misinterpretation which is entailed in any brief categorical statement about a broad subject, I wish to state my personal beliefs—based on more than 30 years of teaching and observation of teachers and students—as to the principles involved in securing the most efficient use of the engineering student's time. These principles should be developed by the faculty working together in a harmonious spirit of teamwork with all the competent advice they can secure from Alumni and industry. The day is past when individual effort can suffice. The effective prosecution of these principles involves a preliminary grading of the field, as it were, so that all the ancient ruts are filled and every member of the faculty is able and willing to put himself in a position to view all matters from the level and not have the objective of "maximum efficiency of use of the student's time" obscured by the side of some time-worn, easy rut, that is hoary with the respectability of age.

These principles are as follows:

First, the total time required of the student for study, class and laboratory work should be such that he can acquire a sense of mastery of his subjects, such that he can actually learn to think in a scientific manner, and have a proper allowance of time left over to learn to live a happy and useful life by participating in the various needed general activities and reactions.

Second, the time allotted to courses should be divided into three groups, and properly proportioned between them.

(a) English and similar general subjects, such as economics and management.

(b) Fundamental mathematics and science.

(c) Applied engineering subjects. These should be taught as added illustrations of scientific principles, as examples of correct engineering thinking, and not as mere practical technique.

The time allotment to each of these three groups must be determined after most careful study of needs from the standpoint of the efficiency objective. My impression is rather strong that we will do well to study carefully the way in which, in the past, the time allotted to applied engineering subjects has been increased and the time devoted to fundamental physical sciences and mathematics decreased. I believe that the demands of the next thirty years for increased efficiency in all engineering undertakings may be better served if we give our students a better grounding in fundamental science even if we have to cut down somewhat on subjects dealing with applied engineering practice.

These time allotments can be made intelligently only after a most careful scrutiny of the details of the subject matter to be taught in each course. This scrutiny—not by the individual teacher alone, but by the whole faculty—will be one of the most fruitful ways in which efficiency in use of the student's time can be promoted.

For the accomplishment of the purpose to make the most efficient use of the student's time, I have stated two principles: (1) Proper division of time between formal course work and other activities; (2) Proper division of time for formal course work between the three divisions of: (a) English and other general subjects; (b) Fundamental mathematics and physical science; and (c) Applied engineering subjects. There is a third which is of vital importance, and that is, Efficient Teaching, by men who know life broadly, as well as scientific principles and engineering technique, who will arouse and stimulate and inspire students to make effective use of all the opportunities provided.

Extract from an address delivered Feb. 1 at the Mid-Winter Reunion and Banquet of the Alumni Association of Rensselaer Polytechnic Institute, and the Induction of Dr. Hotchkiss as President of the Institute.

▼

## The Widened Shoulder as Safety Factor

An interesting instance of the influence of widened road shoulders and shallow side ditches in preventing highway accidents was cited by Mr. James D. Adams, Chairman State Highway Commission of Indiana, in a paper presented at the 22nd annual Purdue Road School. We quote from his paper:

"On last December 24th, I had occasion to motor north from Indianapolis on U. S. Highway 31. The first ten miles out of the city has the wide shoulder with shallow side ditch. The pavement was covered with packed, slick snow. Motorists were skidding about, driving carefully. In spite of caution several cars had slipped from the pavement but with the wide, flat shoulder each was able to get back on the highway on its own power.

"Upon leaving that portion of the highway where the shoulders had been widened and entering upon the portion which has but a 50 ft. right of way with deep abrupt ditches close to the pavement, the scene quickly changed. In the first quarter of a mile, three cars had been in the ditch and each had had to be pulled out by a wrecker. Within a distance of 20 miles, five wrecks were still along the highway. One was a car off the road lying on its side. A little further on, a large ambulance was in the ditch with a bent front wheel. A patient was in the ambulance.

"Still further was a truck with the right rear wheel broken off as the result of a slight skid which landed in the deep, abrupt side ditch. In the remaining distance to the junction with Road 28 two more passenger cars were wrecked, due to sliding off the slippery pavement. But this is only part of the story. No less than 17 additional cars had skidded off the pavement and, owing to the narrow right of way and deep side ditch, had to be taken out with a wrecker.

"By comparison, we had no wrecks on ten miles of widened shoulder as compared to 22 wrecks in 20 miles where the shoulder had not been widened. For the motorist who suffered car damages, he could have afforded to pay a considerable share of his property loss to have had a safer highway on which to drive during a condition such as existed that day."

# TIRE TORTURE NEVER STOPS-
## *Proves Value of New Goodrich Invention*

The tires never even get a chance to cool off. It's load up and drive—load up and drive—24 hours a day, seven days in the week.

This huge truck hauls gold concentrate from the Big Canyon Mine near Placerville, California, to Stockton, 100 miles away. With the price of gold high, mines work overtime, the metal must get to market in a hurry.

### Can't Take Chances

So valuable is the truck, the owners, the United Motor Transport, keep a new Diesel engine in reserve, ready and waiting for instant replacement. They can't take chances on tires either. Schedules are fast. Roads are rocky. Curves are sharp. So every tire on the job is a Triple Protected Silvertown—built for just such heavy-duty service as this.

### Tires Triple Protected

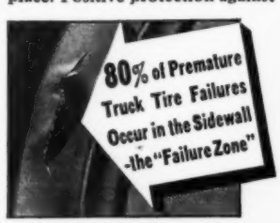
The new Silvertowns actually check 80% of premature failures! A revolutionary invention built into the sidewall guards against blow-outs and road delays. This is the tire that's being used on the world's toughest hauling jobs. If it stands up under that kind of punishment, surely it will do a better job for you, too. Start checking up now. Find out more about the biggest tire development in years—the costly invention that is saving every user money—yet does not cost truckers one cent extra.

### HOW TRIPLE PROTECTION WORKS

**1** **PLYFLEX**—a *new*, tough, sturdy rubber material with greater resistance to stretch. A layer of Plyflex in the sidewall prevents ply separation—distributes stresses—checks local weakness.

**2** **PLY-LOCK**—the new Goodrich way of *locking* the plies about the bead. Anchoring them in place. Positive protection against the short plies tearing loose above the bead.

**3** **100% FULL-FLOATING CORD**—Each cord is surrounded by rubber. With ordinary cross-woven fabric, when the cords touch each other, they rub—get hot—break. In Silvertowns, there are no cross cords. No friction.



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# Goodrich *Triple Protected* Silvertowns

**SPECIFY THESE NEW SILVERTOWN TIRES FOR TRUCKS AND BUSES**

*Completed Asphaltic Concrete Surface Over Old Macadam on Kellam Place, Hempstead, N. Y.*

# OLD STREETS OFFER SOUND FOUNDATION FOR NEW SURFACING

By C. W. McLAUGHLIN

*Village Engineer, Village of Hempsted (L. I.), N. Y.*

THE Village of Hempstead in Nassau County, N. Y., decided, as a part of its 1935 street program, to improve four old, narrow, bituminous macadam streets, which branch east and west from Main Street.

*The Space Between the Old Macadam Surface and the New Concrete Shoulders Is Filled with 1½-in. Stone*

Years of traffic had thoroughly consolidated the old macadam and, appreciating this, the village determined to make use of the old streets as a base for new asphaltic concrete surfacing. In widening the street, care was exercised not to disturb the old metal in any way which would lessen its stability.

*An Application of Sand Was Used to Fill Up Interstices Between Stones*

The earth shoulders on either side of the old surfacing were excavated to make room for a reenforced concrete slab 7 in. deep and 6 to 7 ft. wide. Village officials stressed the importance of performing the excavating for the slab in such a way that the many fine looking old trees lining these streets would not be harmed. For this reason, it was deemed inadvisable to use a steam shovel to excavate. Instead, a bulldozer and a crane were employed, which proved very effective, resulting in no damage whatever being done to the trees. Cutback asphalt was sprayed over the concrete as a curing agent.

*Constructing New Asphaltic Concrete Surface Over Old Macadam*

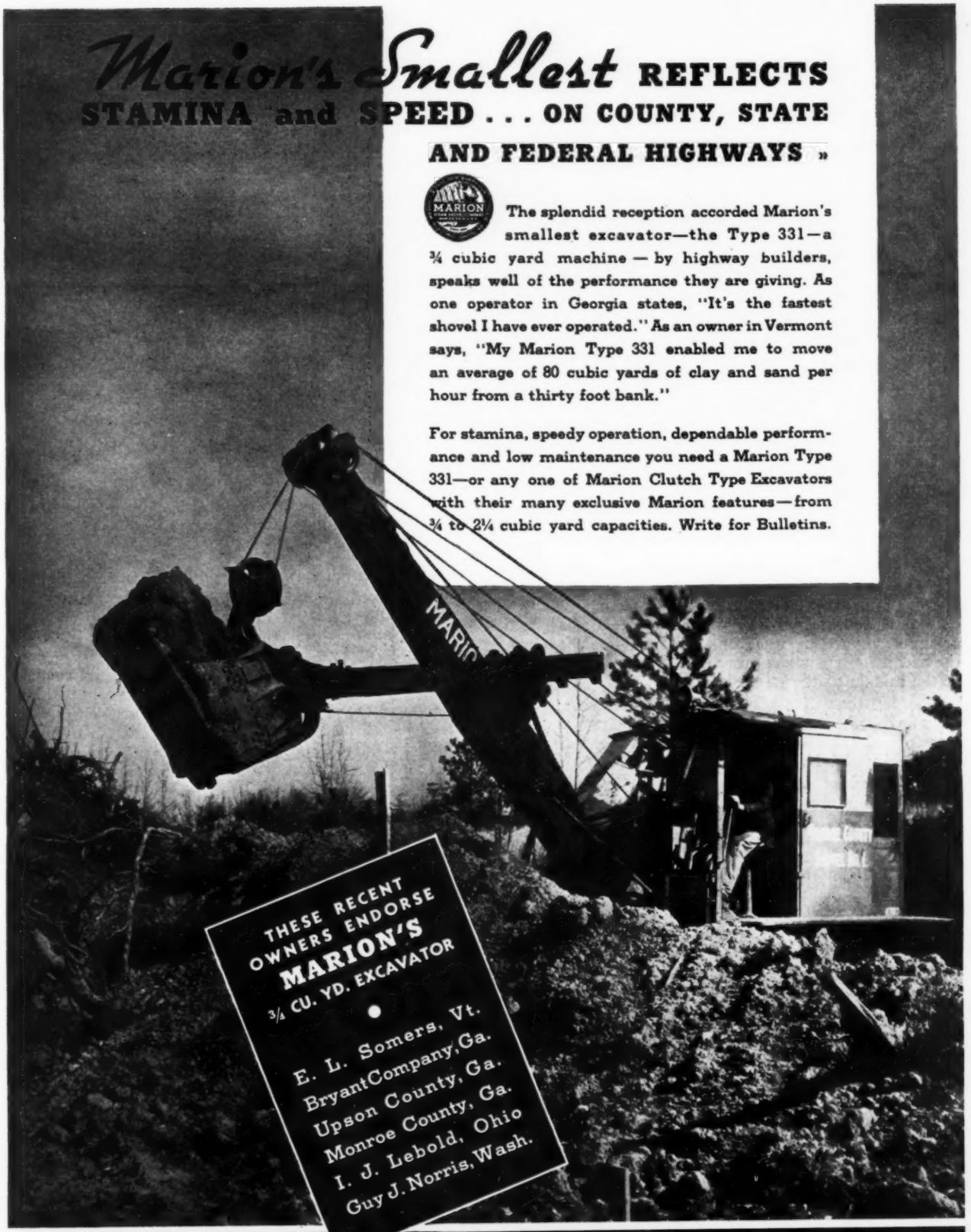
Between the old bituminous macadam surface and the concrete shoulders on either side, there remained an irregular joint varying in width from several inches to two feet. These joints were filled with 1½-in. broken stone, the interstices between the stones being closed up with an application of sand. One of the rear wheels of a 3-wheel roller then compacted the stone to approximately 1 in. below the surface of the concrete.

After the preliminary steps of sweeping the surface free of all loose material, and painting with asphalt cement the edges of the concrete shoulders had been

# Marion's Smallest REFLECTS STAMINA and SPEED . . . ON COUNTY, STATE AND FEDERAL HIGHWAYS »

The splendid reception accorded Marion's smallest excavator—the Type 331—a ¾ cubic yard machine — by highway builders, speaks well of the performance they are giving. As one operator in Georgia states, "It's the fastest shovel I have ever operated." As an owner in Vermont says, "My Marion Type 331 enabled me to move an average of 80 cubic yards of clay and sand per hour from a thirty foot bank."

For stamina, speedy operation, dependable performance and low maintenance you need a Marion Type 331—or any one of Marion Clutch Type Excavators with their many exclusive Marion features—from ¾ to 2¼ cubic yard capacities. Write for Bulletins.




THE MARION STEAM SHOVEL CO., MARION, OHIO, U. S. A.

SHOVELS • CRANES • DRAGLINES • TRENCH SHOVELS • STEAM • GAS • DIESEL • ELECTRIC • DIESEL ELECTRIC • GAS ELECTRIC

• • AN EXCAVATOR FOR EVERY MATERIAL HANDLING JOB • •

*The Asphaltic Concrete Surface Being Rolled to a Level Slightly Above the Concrete Shoulders*

attended to, the street was in readiness for the Texaco asphaltic concrete wearing surface, which was to be laid approximately 20 ft. wide between the concrete shoulders.

For the most part, the asphalt concrete mix was spread to a loose depth of 1½ in. When thoroughly compacted by means of a tandem roller to approximately 1 in. thickness, the asphalt wearing surface stood slightly above the level of the shoulders. Following the rakers and just prior to rolling, a workman with a long-handled lute, in the left foreground, worked this tool from each side of the asphalt toward the center to insure maximum smoothness.

On Columbia Street and a small section of Becell Street, instead of laying a uniform thickness of asphaltic concrete surface, it was considered advisable to bring the new wearing surface from each side to a feather edge at the middle of the street.

The 450 tons of asphaltic concrete mix necessary in resurfacing these four old bituminous macadam streets was furnished and laid by the Andrews Road & Supply Co. of Mineola, N. Y.

C. R. McKay of Garden City, N. Y., was general contractor for the entire project.

▼

## Sources of Revenue for Minnesota Highways

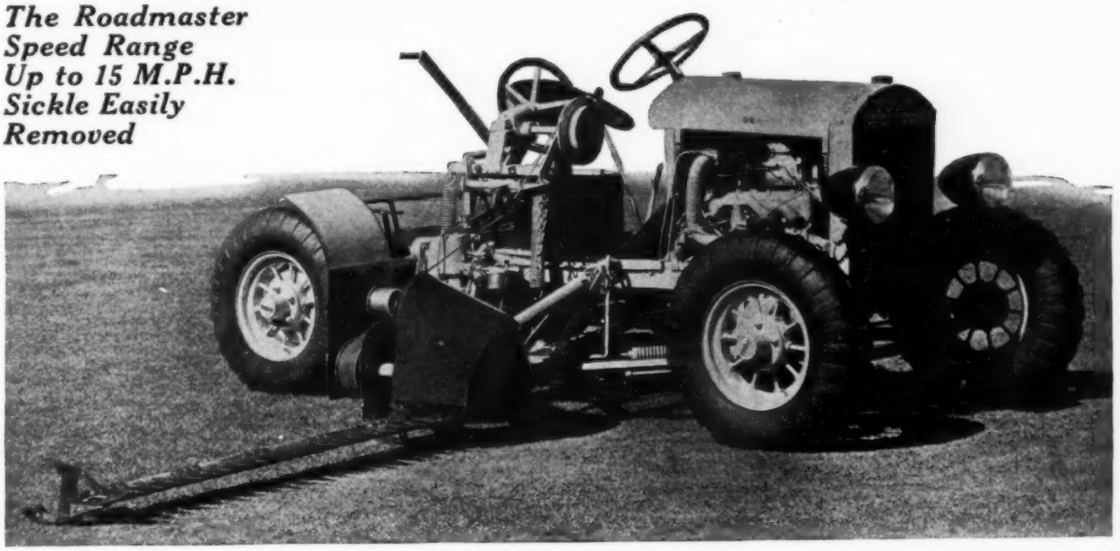
A financial survey having for its primary purpose the determination of all facts connected with the financing of roads and streets in the State of Minnesota was made during 1934 under a cooperative agreement between the Bureau of Public Roads, the Minnesota State Highway Department, and the University of Wisconsin. The study was made under the immediate direction of Dr. Henry R. Trumbower, Professor of Economics at the University of Wisconsin and economist of the Bureau of Public Roads, and H. R. Briggs, field investigator and statistician. The data for the survey were for the calendar year 1932. A digest of the survey with special reference to highways is given in the March issue of Public Roads by Elizabeth Church, Assistant Research Analyst, Division of Highway Transport, U. S. Bureau of Public Roads. The following summary is taken from the digest:

1. There were no expenditures of funds from general property taxes on state highways.
2. Rural property paid no tax for local urban streets and urban property paid no tax for local township roads.
3. Of the total rural property taxes expended for highway purposes—
   (*a*) 55.6 per cent was expended on county trunk highways;
   (*b*) 44.4 per cent was expended on local township roads.
4. Of the total property tax raised from urban communities and expended for street and highway purposes—
   (*a*) 62.2 per cent was expended on county highways;
   (*b*) 37.8 per cent was expended on urban streets.
5. Since, of the total assessed property valuation of $1,884,238,200, 42.9 per cent or $808,798,600 was in rural areas, and 57.1 per cent, or $1,075,439,600 was in the urban units—
   (*a*) Expenditures from property taxes for all highways and streets were at the following rates per $100 of assessed valuation:
   Rural—107.3 cents.
   Urban—66.7 cents.
   (*b*) Expenditures from property taxes for county highways were at the following rates per $100 valuation:
   Rural—59.7 cents.
   Urban—41.5 cents.
   (c) Expenditures from property taxes for local township roads were at the following rates per $100 valuation:
   Rural—47.6 cents.
   Urban—No tax.
   (*d*) Expenditures from property taxes for local urban streets were at the following rates per $100 valuation:
   Rural—No tax.
   Urban—25.2 cents.
6. Of the total property taxes pended on all roads—
   (*a*) 58.6 per cent was expended on county highways;
   (*b*) 24.3 per cent was expended on local township roads;
   (*c*) 17.1 per cent was expended on urban streets.
7. Of the total motor-vehicle imposts expended on all classes of roads and streets—
   (*a*) Rural motor-vehicle owners paid 30.2 per cent and contributed 29.4 per cent of the total travel on all roads and streets;
   (*b*) Urban motor-vehicle owners paid 69.8 per cent and contributed 70.6 per cent of the total travel.
8. Of the total motor-vehicle imposts expended on all classes of roads and streets—
   (*a*) 80.6 per cent was expended on the State trunk highways;
   (*b*) 19.4 per cent was expended on the county highways.
9. Of all taxes and imposts expended on all roads and streets—
   (*a*) 37.1 per cent was expended on State trunk highways;
   (*b*) 33.9 per cent was expended on county highways;
   (*c*) 10.3 per cent was expended on local township roads;
   (*d*) 18.7 per cent was expended on urban streets.
10. Of all taxes and imposts expended on all roads and streets—
   (*a*) Rural property and motor-vehicle owners paid 36.8 per cent and contributed 29.4 per cent of the total travel on all roads and streets;
   (*b*) City and village property and motor-vehicle owners paid 63.2 per cent and contributed 70.6 per cent of the travel.

# TORO

## ALL OVER THE WORLD

*The Roadmaster*
*Speed Range*
*Up to 15 M.P.H.*
*Sickle Easily*
*Removed*



# The TORO ROADMASTER

## Cuts the Toughest Growth . . . EASILY!

A NEW, improved tractor built specially for highway and other heavy duty cutting . . . designed and built for easy, fast and economical operation. No special skill required. Ford Model B motor with self starter and standard gear shift. Transporting speed up to 50 miles per hour for quick trips between jobs. Cutting unit detached in 30 minutes.

The ONLY tractor mower with sickle bar driven by an independent motor, (TORO 2 H.P. air-cooled 4-cycle with automatic governor control) with sickle carried on a separate pneumatic tired wheel and which can be operated in a cutting range of 150 degrees (90° above horizontal and 60° below horizontal). Releasing device permits cutting unit to swing back when obstructions are hit. Worm gear lift for full lift and emergency hand lift for quick partial lift.

Write for folder giving full information and specifications.

**TORO MANUFACTURING CORPORATION**
OF MINNESOTA
3042 Snelling Ave., Minneapolis, Minnesota, U.S.A.

*Fine Grading and Rolling Subgrade for New Lane of Concrete on U. S. Route 40 in Wayne County, Between Dublin and Mount Auburn*

# SOME FEATURES OF INDIANA'S ROAD WIDENING PROGRAM

DURING 1935 the state highway department has started work or completed approximately 83 miles of a widening program in and near Indianapolis, the state's most important metropolis. This program, plus the 27 miles of roads already three or more lanes wide will make Indianapolis one of the most accessible large cities in the country. On these heavily traveled roads, a standard 9-7-9 in. cross section of concrete is used. But where two lanes are added to an existing 2-lane pavement, one lane is added at each side where grade and alignment of the old pavement are satisfactory.

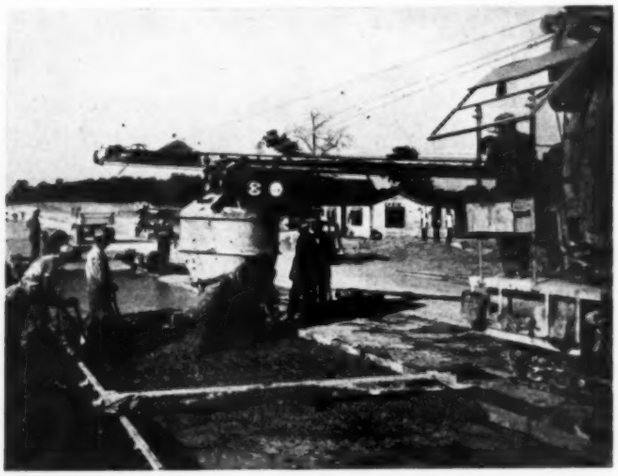
Traffic naturally selects the new outer lanes, leaving the old pavement on the inside for passing and for peak hours. Chance for collision is thus greatly reduced. And, by relieving the old center pavement of heavy travel, its life is lengthened.

Later, when the increase in traffic justifies farther improvement, additional lanes will be built along the outer side of the pavement now being built. The old slab will then be torn out and the space planted as a parkway, thereby giving increased traffic capacity and greater safety.

These improvements have been supplemented by street modernization on a number of Indianapolis' busier streets, and by improvements to streets forming a part of these roads in a number of smaller cities through which the widening extends.

One important project, based on heavy use, is the widening and relocation in some sections of U. S. 52 throughout its entire length from Indianapolis to Lebanon, 26 miles to the northwest. This pavement is three and four lanes wide. In many cases, new right-of-way was obtained to eliminate and ease curves. Several large cuts were made that traffic could hew to the shortest, safest line. This improvement is complete except for

*In Some Towns, Car Tracks Were Torn Out and Replaced with Concrete as Busses Were Substituted for Street Cars*



*Concreting Operations on U. S. 41 South of Dyer, Ind. for Widening to 40 Ft.*

# 5 for William L. Lathers, Jr.

At Black Earth, Wisconsin, "Bill" Lathers used five 7 yd. Continental Scraper Wagons on a highway grading job that involved digging and handling some 149,000 yards of sandy clay mixed with shale and gravel. And what a record he made! Using "A-C, L.O's" for power on an average haul of 475 feet (1,000 ft. round trip), the Continental Wagon Scrapers handled plus 6.1 yards per load — 163 trips per 10 hour shift — 4 minutes per trip, or almost 100 yards per hour per scraper — 5,000 yards per shift with five 7 yd. Continental Wagon Scrapers — 149,000 yards in 29 days! You've read the speed record — now look at the costs! Total operating costs were *only 3.5c per yard* — including complete tractor and wagon scraper costs, operators' wages, gasoline, oil, depreciation and interest. (No general overhead or grade finishing costs included.)

"Bill" Lathers knows that Continental Wagon Scrapers are the fastest, lowest cost dirt moving equipment made. That they are lighter in weight, yet stronger and of greater capacity per pound of weight than any scrapers made. You should know, too, that they dig — load — haul — and dump over banks, or in windrows — that they backfill — turn short — dump in close quarters against walls, around culverts, and can also be used as carry wagons.

Continental Wagon Scrapers are real one-man outfits — tractor operator controls all operations — with a single valve from the tractor seat. Made in 5 and 7 yard sizes for use with crawler tractors.

*For lowest cost dirt moving — use Continental Wagon Scrapers — send for user reports — do it now!*

**TRACTOR EQUIPMENT DIVISION**
**CONTINENTAL ROLL & STEEL FOUNDRY CO.**
332 S. Michigan Ave., Chicago, Ill.

*30 Ft. Finishing Equipment in Use on U. S. 41 for the 3-Lane Pavement*

a grade separation near Indianapolis, which will be finished during the early summer.

On U. S. 40, 16 miles are being widened to three and four lanes east from Terre Haute and plans are being prepared for widening another section east of Brazil. Last year 15 miles of U. S. 40, west of Richmond, was widened to three lanes, while in small towns between Indianapolis and Richmond, street car tracks were ripped out and paved or prepared for paving between the rails. In other cases, entrances to these and other small towns are being widened.

Three-lane concrete on U. S. 40 now extends from Indianapolis to Greenfield, James Whitcomb Riley's home town, 16 miles east. And west of Indianapolis, motorists find six miles of 3 and 4-lane pavement. So, all in all, a wide U. S. 40 across Indiana is not so far afield. The need is shown by the traffic, which averages over 5,000 cars on Sunday. Some sections, near Indianapolis, carry as high as 10,000 cars daily.

Another attack on crowded travel is being made with the widening of State Road 67 northeast from Indianapolis to Anderson, a distance of 36 miles, and construction of a by-pass around Anderson. Final sections of this improvement are under contract for completion in 1936. A major part of the widening on Road 67 has been finished. This widening, too, was badly needed for Road 67 carries an average of some 4,000 cars daily, with Sunday traffic bounding up to more than 7,000 cars.

The latest super-highway to be initiated is a 15-mile section of divided lane highway replacing the present U. S. 30 route between Road 41 and the Lake-Porter county line. This highway, consisting of two 22-ft. concrete lanes separated by a 40-ft. parkway, will be a boon to traffic entering and leaving Chicago. U. S. 41 is also being widened from 18 to 30 feet for about 15 miles, extending south from U. S. 30 toward Terre Haute, another aid to traffic in and out of Chicago.

While much remains to be done before Indiana's widening and city entrance needs are complete, that state may rightfully be proud of its leading position in this highly essential program of relieving traffic congestion and providing modern safe motoring facilities.

▼

GRADE CROSSING TOTALS.—Reports of the Interstate Commerce Commission show 2,109 railroad grade crossings were eliminated during 1934, the most recent year for which detailed figures are available. A total of 999 new crossings were added, however, making the net decrease in grade crossings during the year amount to 1,110. The end of 1934 showed a total of 234,486 grade crossings, as compared with the corresponding total of 235,158 for 1926.

## A. S. T. M. Committee on Concrete and Concrete Aggregates

A number of developments in the American Society for Testing Materials work pertaining to concrete and concrete aggregates were discussed at the meeting of Committee C-9 in Pittsburgh during Committee Week, March 2-6. Professor Arthur N. Talbot, University of Illinois, was unanimously elected Honorary Chairman of Committee C-9 in recognition of his eminent service and contribution to the work of the committee.

The committee has made quite a study of concrete nomenclature and has completed the preparation of new definitions for the terms "admixture," "blast furnace slag," "crushed stone," "gravel," "crushed gravel" and "fineness modulus," which are to be presented to the society for publication as tentative definitions.

The committee has also completed the preparation of a new tentative method of flexure testing of concrete which makes use of the third point leading method and is in conformity with the method of the American Association of State Highway Officials. This method is to be presented for publication as tentative this year by the A.S.T.M. to replace the existing Tentative Laboratory Method of Making Flexure Tests of Concrete Using a Simple Beam with Center Loading (C 78-30 T).

The committee has also reviewed the various standards and tentative standards under its jurisdiction and proposes to recommend the adoption as standard of the following tentative specifications and methods:

Tentative Specifications for Sodium Silicate for Curing Concrete (C 111-34 T).

Tentative Method of Test for Structural Strength of Fine Aggregate Using Constant Water-Cement-Ratio Mortar (C 87-32 T).

Tentative Method of Test for Absorption by Aggregates for Concrete (Laboratory Determinations) (C 95-33 T).

Tentative Method of Field Test for Absorption of Mixing Water by Aggregates for Concrete (C 96-33 T).

Tentative Method of Making Compression Tests of Concrete Using Portions of Beams Broken in Flexure (C 116-35 T).

Tentative revision of Standard Method of Test for Sieve Analysis of Aggregates for Concrete (C 41-33).

The committee has also endorsed the Simplified Practice Recommendation for Coarse Aggregates (Crushed Stone, Gravel and Slag) in so far as it applies to concrete aggregates.

The committee has been studying for some time tests for deleterious substances in aggregates and has completed for publication as tentative a new Method of Test for the Determination of Coal and Lignite in Sand.

Action was taken to recommend the inclusion in the annual report of the committee this year of a paper on "Studies on Relation Between Characteristics of Blast Furnace Slag and Other Coarse Aggregates and the Properties of the Resultant Concrete" by Fred Hubbard, Consulting Engineer, The Standard Slag Co., Youngstown, Ohio.

The officers of Committee C-9 are: Chairman—R. W. Crum, Director, Highway Research Board, National Research Council; Secretary—R. R. Litehiser, Chief Engineer, Bureau of Tests, Ohio State Highway Testing Laboratory.

# AND AFTER APRIL SHOWERS

## THE DIRT BEGINS TO FLY . . . .

"Move the trucks up fast enough and the AMERICAN GOPHER will keep them busy"—so we said when this versatile excavator was introduced eight years ago—and the record of achievement since has shown that wherever the GOPHER has been on the job it has more than lived up to this modest claim we made for it.

Simple in design, sturdy in construction, and easy and economical to operate, the GOPHER has set a performance record of which we are proud. It will produce maximum yardage at a minimum of cost—a fact that means profit dollars on your ledgers.

Convertible as shovel, crane, or dragline—in sizes from ½-yard to 2-yard and furnished with gasoline, electric or Diesel power— the GOPHER will meet the demands of the job you put it on. Let us send you our latest descriptive literature.

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AMERICAN GOPHER

AMERICAN GOPHER SHOVELS SINCE 1905

AMERICAN GOPHER SHOVELS
CRANES · DRAGLINES

# MAXIMUM VEHICLE CAPACITY OF A HIGHWAY

WHAT is probably the most extensive highway accident survey ever undertaken was completed last year in Massachusetts. The survey was organized in December, 1933, under the supervision of the Massachusetts Institute of Technology and operated as a project of the Civil Works Administration and later of the Emergency Relief Administration. It continued until the last of September, 1934. The Federal government provided upwards of $400,000 for the services of engineers, statisticians, clerks, and all other labor. Col. Robert C. Eddy was director of the survey, his services being donated by Massachusetts Institute of Technology.

During the course of the survey a mass of data was accumulated. In the studies of the behavior of cars on the road alone over 2,500,000 cars were observed and their actions studied. Statistics of accident records for about 200 towns and cities were made. Numerous other studies also were made during the survey. Abstracts and resumes of various reports giving only facts and conclusions of general interest, have been assembled in a report, which was issued a few weeks ago. One section of this report deals with the mathematical analysis of accident situations, and from that section we have taken the matter that follows.

*Safe Following Distance.*—Various formulas have been suggested for the safe distance to be maintained between two vehicles following one another at the same speeds, and for the corollary, the maximum vehicle capacity of a single lane. The earlier of these formulas were based upon the braking distance of the following car. Later on an allowance was made for the perception time and reaction time of the driver. These formulas were of the form:

$$S = aM^2 + bM + c$$

Where S = distance — center to center of vehicles — feet

M = speed in miles per hour

$a = \frac{1.08}{d}$ where d = deceleration rate is fpsps

b = 1.47 × reaction time in seconds

c = length of vehicle plus clear distance between at standstill

Prof. Daugherty of the University of Tennessee has given this formula as:

$$S = .056M^2 + 0.73\ M + 15 \qquad (1)$$

which allows for braking to a standstill at 19 fpsps, ½ second reaction time, and no space between bumpers at rest. This formula was adopted by the Philadelphia (Tri-State) Report of 1930.

The Regional Plan for New York adopted:

$$S = .072M^2 + 0.733M + L$$

which allowed for braking to standstill at 15 fpsps, ½ second reaction time, and no spacing between bumpers at standstill.

It is evident, however, that it is unnecessary to allow space for the following car to brake to rest; for by the time the following car has come to a standstill, the leading car has gone a considerable distance even if braking at a high rate.

If the two cars are braked at identical rates, it is necessary that braking of the following car be begun when its forward bumper is not further along than the same position on the road that the rear bumper of the leading car occupied when its brakes were applied. The cars would then come to rest with their bumpers touching. Practically, some additional space is required. For this condition, the formula reduces to:

$$S = bM + c$$

This is the absolute minimum permissible spacing unless it is known positively that the following car has better braking ability than the leading car. As the relative braking ability of the two cars is generally unknown, it should be assumed that the leading car has somewhat the better of it. This formula has been suggested by some. Mr. Sigvald Johanneson has given it as:

$$S = 2.2M + 25 \qquad (2)$$

which allows 1.5 seconds for perception plus reaction time and 10 ft. clear space between vehicles at rest.

It would seem that some additional allowance should be made for the unknown superiority in braking ability of the car ahead. In the spring of 1934 the Equipment Section of the Massachusetts Registry of Motor Vehicles tested, on the road, 687 pleasure vehicles with four-wheel brakes. Seventy-six per cent of these could be stopped from 20 m.p.h. in the standard distance of 30 ft. or less. Only about 4 per cent, however, could be stopped in less than about 20 ft.

Still using the formulas based on constant coefficient of friction, we find that if there is a difference of $D_2$-$D_1$ in the braking distance from 20 m.p.h. of the cars, the above formulas become

$$S = \frac{D_2\text{-}D_1}{400} M^2 + 1.47\ t_r\ M + S$$

when $D_1$ = braking distance from 20 m.p.h.—leading car

$D_2$ = braking distance from 20 m.p.h.—following car

M = speed, miles per hour

$t_r$ = perception plus reaction time

$S_o$ = distance between cars at standstill

If we assume a difference in braking distance at 20 m.p.h. of 10 ft, a reaction time of 1 second, and a distance between bumpers at standstill of 5 ft., we have:

$$S = .025\ M^2 + 1.47\ M + 20 \qquad (3)$$

It is interesting to note that in 1927 the Highway Research Board recommended:

$$S = .0366\ M^2 + 1.10\ M + 17$$

which corresponds to a difference in stopping distance of 14.7 ft. and ¾ second reaction time.

In 1931 Mr. H. H. Allen of the U. S. Bureau of Standards suggested that braking rates of 15 and 28 fpsps be taken for the two cars, with ½ second reaction time, and proposed the formula:

$$S = .0333M^2 + .733\ M + 14$$

All the foregoing discussion assumes constant coefficient of friction for all speeds. If we assume, tentatively, that this coefficient so varies that braking distances are proportional to the 2.3 power of the speed, we have as a formula for the required spacing:

$$S = D_2\text{-}M_1\ 2.3 + 1.47 t_r\ M + S_o$$

**Damage to Highways in State Caused by Frost of Last Winter Worst in History of Motor Travel**

Miles of Roads in Many Areas Are Affected by Severe Weather; Repair Work Is Under Way ...h With Number of Projects ...Routes and Boulevards

**SPRING FINDS STATE ROADS IN POOR REPAIR**

Severe Winter Caused Much Damage and Funds Are Low

# *Let it thaw!*

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WHEN the frost comes out or the rain pours down, concrete's sterling value becomes outstanding because SOFTENED SUBGRADES HOLD NO TERRORS FOR CONCRETE.

Its beam strength bridges over soft subgrades, distributes the loads and so keeps the pressure on weakened subgrades within safe limits.

The spring thaws and rains following last winter's deep frost and heavy snow put all roads, over a wide area of the country, to a severe test.

But concrete showed it could take the gaff and required no costly rebuilding. Even after being subjected to severe frost heaving and continuous traffic over badly softened subgrades, routine inexpensive maintenance quickly puts concrete in prime condition for heavy summer traffic.

There is little or no interruption of service. Aggravating detours and costly delays are avoided. Concrete is safe, economical and usable, in all seasons, rain or shine, day or night.

Drive your roads while the results of the spring break-up are apparent. Learn the lesson first-hand observation teaches. Then build your next road with dependable all-season concrete.

Let us help by sending any or all of the volumes in the Concrete Pavement Library.

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Please send literature checked: ☐ Rational Planning of a Public Highway Program ☐ Concrete Road Design Simplified and Correlated with Traffic ☐ Short Count Traffic Surveys ☐ What Old Concrete Roads Tell Us ☐ Concrete Pavement Manual.

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Position.....

Address.....

City.....State.....

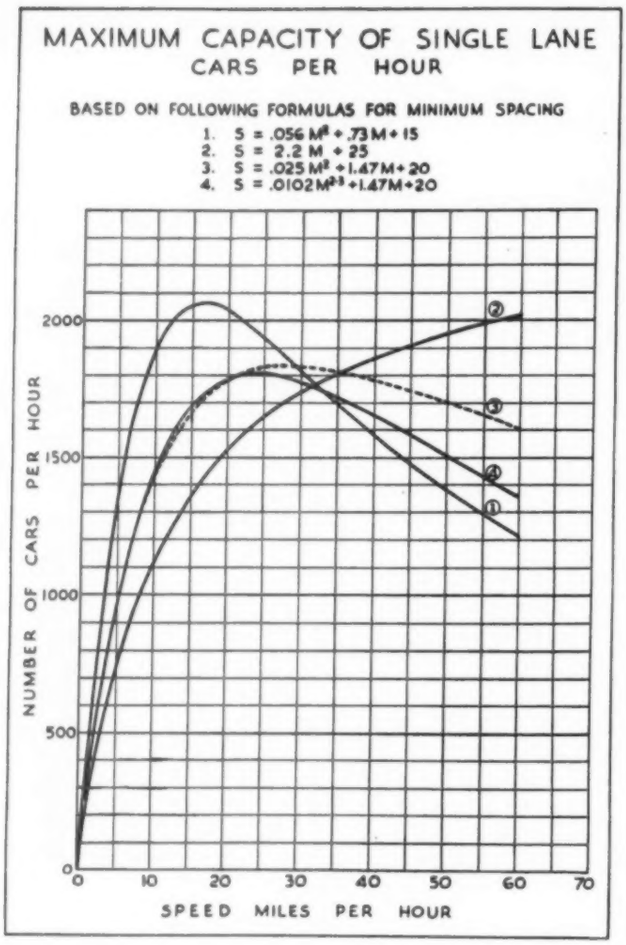


*Fig. 1—Maximum Capacity of Single Lane*

It is noted here that the coefficient of the first term is altered from 1/400, as required by the formula for braking distance, $S = D\text{-}M^2/400$ when the square of M is used, to 1/982.4 in the formula $S = DM^{2.3}/982.4$, in order that D may still represent the braking distance from 20 miles per hour.

If we assume that the brakes of the following car are just passable by Massachusetts requirments (capable of stopping in 30 ft. from 20 m.p.h.) and that the brakes of the car ahead can stop the car in 10 ft. less distance, we have

$$S = \frac{10}{982.4} M^{2.3} + 1.47 t_r M + S_o$$

$$= .0102\ M^{2.3} + 1.47\ M + 20$$

when $t_r = 1$ and $S_o = 20$ feet (length of car plus 5 feet)

To give some quantitative idea of the safe spacing indicated by these formulas, we have the following tabulation:

SAFE FOLLOWING DISTANCE—FEET

| Formula | Speed—m.p.h. | | | | | |
|---|---|---|---|---|---|---|
| | 10 | 20 | 30 | 40 | 50 | 60 |
| (1) .056 $M^2$ + .73 M + 15..... | 28 | 52 | 87 | 134 | 192 | 261 |
| (2) 2.2 M + 25..... | 47 | 69 | 91 | 113 | 135 | 157 |
| (3) 0.25 $M^2$ + 1.47 M + 20..... | 37 | 59 | 87 | 119 | 156 | 198 |
| (4) .0102 $M^{2.3}$ + 1.47 M + 20.... | 37 | 59 | 89 | 128 | 176 | 233 |

*Capacity of Highway.*—The capacity of a single lane of highway, although not a factor of accident situations, is a natural deduction from the discussion of minimum spacing of cars in line, and is of importance in the planning of highways. The connecting formula is:

$$\text{Cars per hour} = \frac{5280 \times \text{mph}}{\text{Feet spacing}}$$

Figure 1 shows the variation of lane capacity with speed for four spacing formulas. These are typical of numerous variant forms of formulas used by different authorities. It should be noted that if the formula for spacing involved only the first power of the speed, the resulting capacity of lane increased indefinitely with the speed, although this increase is at a decreasing rate as the speed increases. If the speed is involved in the spacing formula in a power higher than the first, there is a maximum point in the capacity curve.

An interesting corollary of this analysis of highway capacity is the case where a two-lane road is reduced at some point to one lane. If more cars present themselves on this road than can be accommodated by a single lane, congestion occurs and traffic is backed up on the two-lane road. Suppose we use Curve 3 in Fig. 1 as representing the lane capacity. This congestion will occur if cars present themselves at a faster rate than 1800 cars per hour no matter how fast travel is permissible on the one-lane section. Each lane of the two-lane section must, therefore, discharge cars at a rate not exceeding 900 cars per hour. But this is accomplished at a speed of about 5 mph. Hence no matter how full the single lane may be, in time of congestion traffic cannot pass along the two-lane road faster than 5 mph. This adequately accounts for the extremely slow speeds often encountered along congested highways.

▼

## Soil Quality Tests for California Highways

During the season of 1934 greater effort was concentrated by the California Division of Highways in the selection of material for the immediaite subgrade for pavements. Complete soil testing equipment was set up in five of the eleven districts of the state, and as a result they were in a position to do their own routine testing. In the October issue of *California Highways and Public Works,* Earl Withycombe, Assistant Construction Engineer of the Division, comments as follows on these tests:

"For the remote districts, this procedure materially speeds up the decision relative to treatment of soils and has worked out very advantageously. The construction personnel are becoming more familiar with the identification of questionable materials, and the danger of such material not being recognized and used without testing is considerably lessened.

"The test of soil quality to which most significance is attached is the bearing value. In this test the bearing value of the soil is compared to that obtained with a good crushed rock surfacing, and is reported in percentages.

"The test is made on the material in a saturated condition as well as with a normal moisture content. For pavement subgrade, the material must show a bearing power of not less than 10 per cent of that obtained in a saturated condition.

"Should the bearing value fall below 10 per cent, the grade is blanketed with from 8 to 24 in. of selected material which will meet the above requirement, the depth depending up the quality of the underlying material. Under pavements subject to leakage of surface water, a membrane of "E" grade asphalt is applied to the surface of the objectionable material before blanketing with selected material."

# *Controlled Quality in*

# LOW COST ROADS

WHEN Bituminous Roads fail, they fail in spots. Ravelling starts in those sections that have a deficiency of bituminous binder. "Bleeding" reflects an excess of bitumen. "Low Cost" means the taking of every advantage of favorable local conditions. Local aggregates must be used, using natural conditions for drying. These must be proportioned exactly and uniformly to the bitumen with a thorough mixing that coats all surfaces of every particle of aggregate.

Barber-Greene Bituminous Pavers have been designed to meet these requirements, and during the last five years have laid hundreds of miles of bituminous roads under a wide variety of local conditions without a single failure or rejection.

The B-G Travel Plant picks up the aggregate, windrowed down the road, *accurately* proportions it with bitumen, completely coats the aggregate, *thoroughly* mixes the materials, and discharges the uniform mixture into a windrow on the primed road. The mixed material is spread by blades or a finisher.

The two fundamentals of the B-G process that so greatly improve the road quality are—*accurate proportioning* and *thorough mixing.* Both are necessary. One without the other is almost worthless.

The B-G Travel Plant carries the bitumen and picks up the aggregate. (Obviously the only way to accurately measure.) The bitumen pump and aggregate feeder are interlocked. Once the ratio is set, there can be no change in proportion, regardless of the operator, engine speed, or amount of aggregate in the windrow.

If the only advantages of the B-G Travel Plant were this accurate proportioning and thorough mixing, it would *challenge the wisdom of using any other road mix method,* but there are many additional advantages.

The trucks work independently—do not have to be synchronized with the machine's progress. Operations are centralized—no costly supervision. There is *never any partially mixed material* in front of the machine to be rained on. The mixed material behind the machine is left in a windrow that is impervious to water.

The B-G Plant has successfully used the material on the road. The old road is scarified, windrowed, and the B-G Plant operates as usual, salvaging this material.

The B-G Travel Plant effects savings in bitumen by immediate control of the mix, elimination of drainage into the base, and the elimination of bleeding.

The two minute cycle required for the entire proportioning and mixing process allows no time for congealing, thus allowing work in much colder atmospheric temperatures. This materially lengthens the working *day and working season,* and allows the use of much heavier bitumens than blades can handle. Many B-G Plants work 24 hours a day. This short cycle also permits the use of heavy base, rapid curing cutback asphalts with the dense aggregates that State Engineers have been striving for, and that has been impossible with other road mix methods.

*The B-G Plant gives plant mix quality at road mix costs,* and no other method approaching these costs maintains the controlled conditions of the proportioning and mixing that are essential for durable bituminous roads.

We offer a heavy model for dense mixtures with a capacity of 1½ to 2 cubic yards per minute. Also a smaller County Model, with a capacity of ¾ to 1¼ cubic yards per minute.

The County Model consists of two units, the Loader and Mixer, coupled together to form the Travel Plant. The Mixer may be used alone as a stationary plant for either bituminous or stabilized roads. The Loader is unnecessary in this case, and may be used independently for various loader jobs.

For complete information, phone, wire, or write. There is no obligation.

**Barber-Greene Company, Aurora, Illinois**

# ACCIDENT EXPERIENCE ON NEW JERSEY'S HEAVIEST TRAVELED HIGHWAY

By ARNOLD H. VEY
*Traffic Engineer, New Jersey State Highway Department*

DURING the time for which the accident experience has been tabulated, this highway represented a concrete roadway having available at least four lanes for vehicular travel, as well as clover leaf grade separation at a major crossing, several traffic circles at other important intersections, traffic control signals at intersections where cross street traffic might be sufficient to warrant the alternation of the right of way, unpaved shoulder paralleling the pavement of sufficient width to permit the parking or stopping of vehicles without interfering with the portion of the highway normally used for travel, as well as elevated and depressed roadways through the congested district on the eastern end.

Yet, during the years 1933 and 1934, this roadway experienced 2,457 reported accidents or the equivalent of about 21 accidents per mile of highway yearly.

*Accident Severity*—From the illustration Fig. 1, a comparison can be made of not only total accident experience on this roadway for the two years but also the number of fatal, nonfatal and property damage accidents. The 67 and 69 fatal accidents resulted in 78 and 90 persons killed, respectively, for 1933 and 1934. The non-fatal accidents caused injury to many times that number—probably 800 to 1,000 persons per year.

*Location of Accidents*—Figure 2 illustrates the comparison of accident experience insofar as location is concerned—that is—those which occurred at intersections and those which occurred between intersections. It will be noted that of the total accidents, 40 per cent or 959 occurred at street intersections, while the remaining 60 per cent or 1,498 occurred between intersections.

It will also be noted from this chart that the hazards of darkness or insufficient vision had a greater effect on

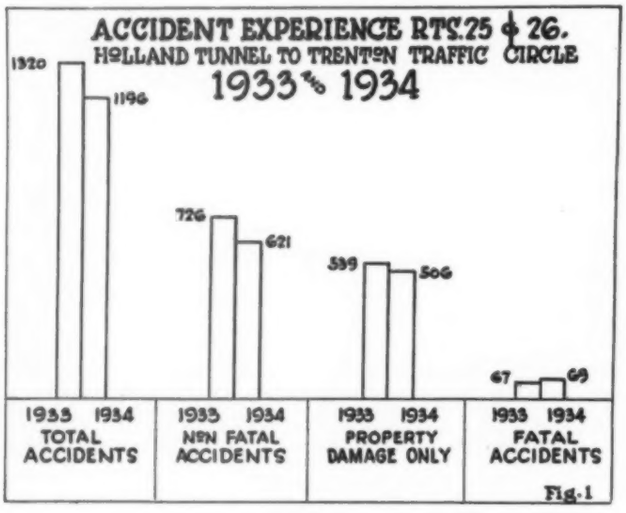


*Fig.* 1

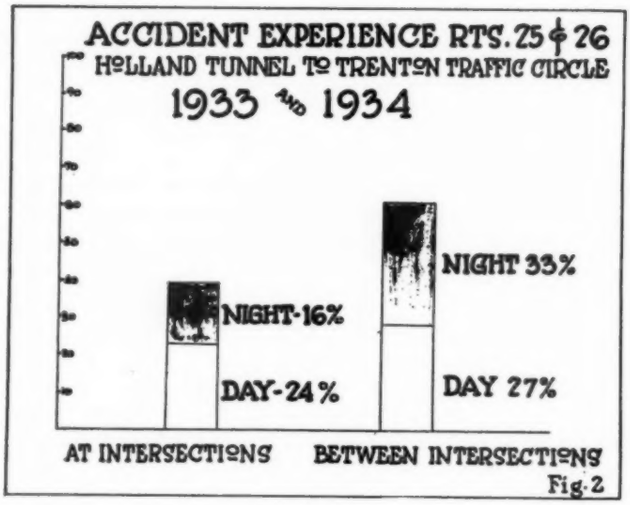


*Fig. 2*

between intersection accidents than intersection accidents. More than one-half of the between intersection accidents occurred at night, while of the intersection accidents slightly more than one-third occurred during hours of darkness.

*Monthly Distribution of Accidents*—Figure 3 illustrates distribution of total accidents and fatal accidents over a two-year period for the different months of the year.

It is interesting to note the general similarity between the total accident curve and the curve indicating monthly distribution of traffic volume.

It is interesting, too, to note that during the fall and winter months, from September to March, the total accident curve rises above the volume curve, while during the summer months the reverse occurs. A general explanation for this, I believe, are the hazards of winter driving due to inclement weather and pavement conditions as well as the hazards brought about by longer hours of darkness during the fall and winter period.

*Daily Distribution of Accidents*—Figure 4 is similar to Fig. 3 except that it shows daily distributon of total accidents, fatal accidents and traffic volume. Again a similarity between total accidents and traffic volume will be noted.

*Hourly Distribution of Accidents*—Figure 5 illustrates accident experience for the two years by the various hours of the day.

It may be determined from the chart that approximately 49 per cent of the fatal accidents and 66 per cent of the total accidents occurred during night hours.

*Types of Accidents*—Figure 6 illustrates percentage of distribution of accidents by their types and further

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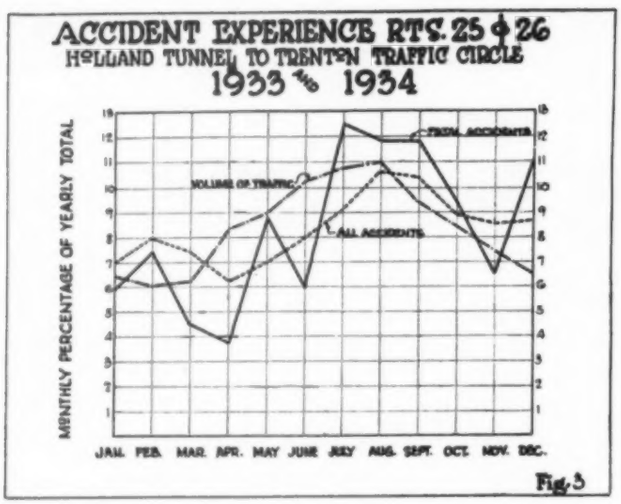
ACCIDENT EXPERIENCE RTS. 25 & 26
HOLLAND TUNNEL TO TRENTON TRAFFIC CIRCLE
1933 AND 1934
MONTHLY PERCENTAGE OF YEARLY TOTAL
FATAL ACCIDENTS
VOLUME OF TRAFFIC
ALL ACCIDENTS
JAN. FEB. MAR. APR. MAY JUNE JULY AUG. SEPT. OCT. NOV. DEC.
Fig. 3

*Fig. 3*

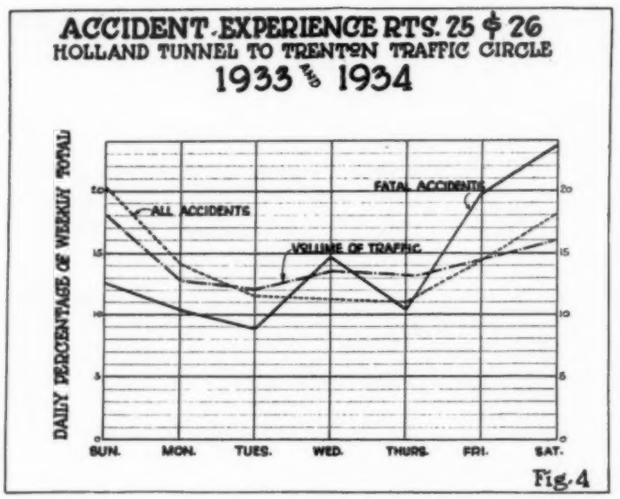
ACCIDENT EXPERIENCE RTS. 25 & 26
HOLLAND TUNNEL TO TRENTON TRAFFIC CIRCLE
1933 TO 1934
DAILY PERCENTAGE OF WEEKLY TOTAL
ALL ACCIDENTS
FATAL ACCIDENTS
VOLUME OF TRAFFIC
SUN. MON. TUES. WED. THURS. FRI. SAT.
Fig. 4

*Fig. 4*

segregates the types into the location of occurrence—whether at intersection or between intersections.

It will be noted from this chart that the most prevalent of all types of accidents is that of collisions between vehicles going in the same direction—51 per cent of all accidents concerned this type. The second most important was head-on collisions between vehicles going in opposite directions—18 per cent, while 10 per cent involved collisions with fixed objects and collisions with pedestrians and 6 per cent each involved head-on collisions and vehicles going in opposite directions where one vehicle was or both vehicles were making a left turn. It will further be noted that with the exception of right angle collisions and collisions between vehicles going in opposite directions where one was or both were making a left turn, all other types of accidents were more prevalent at between intersection locations than at intersections.

*Accident Causes*—The majority of reported accidents did not give the cause of the accident. There are, however, some reports which stated the following as the cause:

> Lost control of vehicle, skidded, stopped too quickly, blinded by headlights, blinded by smoke, collided with car parked on pavement, crossed against signal, made improper turn, fell asleep, had been drinking, headlight or tail light out, blowout, etc.

To these causes might be added other prevalent improper driving practices, such as:

> Too fast a speed for the conditions then existing, driving too close to vehicle ahead, improper passing, failing to grant right of way, passing on dirt shoulder, pulling away from curb without determining the presence of approaching traffic, failing to give hand signals, etc.

*The Remedy*—It is of course determined from this rather hurried review of accident experience along this roadway that most motor vehicle accidents are caused by some improper action on the part of the person or persons involved, regardless of whether such action was wilful, negligent or due to ignorance. It is therefore reasonable to suppose that if highway users knew and would voluntarily observe safe highway practices at all times when upon the highways, the present day accident problem would be materially minimized if not practically eliminated.

On the other hand, however, because of the failures in human elements as well as the difficulty of successfully dealing with these elements through education and enforcement, safety upon the streets and highways is made most difficult. It is therefore essential in my opinion that in order to minimize the shortcomings and

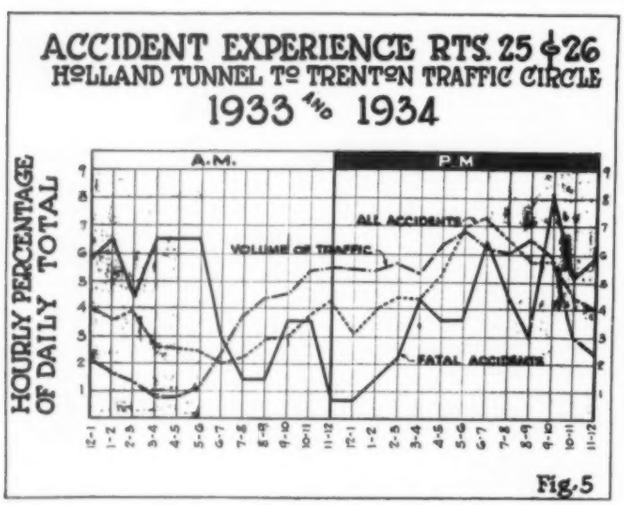


*Fig. 5*

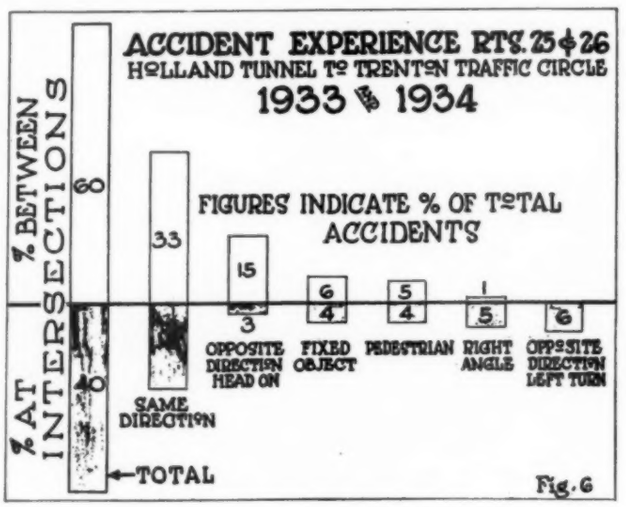


*Fig. 6*

THEY SHALL NOT PASS !
. . . and because of the resilience of
PITTSBURGH SAFETY HIGHWAY GUARD
they will not damage the car or injure the
passengers seriously or destroy the guard

Pittsburgh Safety Highway Guard is the ideal road guard for these reasons:

RESILIENT: It is a 14" wide continuous band of tightly interlaced heavy gauge semi-spring-steel wires, whose tensile strength in continuous line wires is guaranteed to run more than 190,000 pounds per square inch of steel.

EASILY REPAIRED: It can be quickly repaired on the site by common labor. Extent of damage to guard is usually limited to a few displaced vertical wires.

ECONOMICAL: The original cost, the cost of repairs and maintenance are absurdly low.

SAFE: Its great strength and resilience serves to deflect and stop a car with only slight damage to the car or injury to passengers, and practically no damage at all to the guard.

ADAPTABLE: Pittsburgh Safety Highway Guard can be adapted to any curve or grade condition.

Highway engineers will, of course, want to know how Pittsburgh Safety Highway Guard stands up under actual service conditions. This question has been fully answered in a report of a survey made by the Pittsburgh Testing Laboratory. A copy of the report is available on request.

Pittsburgh Steel Co.
742 Union Trust Bldg.,
Pittsburgh, Pa.

Gentlemen:

Please send me, free, a copy of the investigators' report on Pittsburgh Safety Highway Guard.

NAME .....

ADDRESS .....

## PITTSBURGH STEEL COMPANY

**742 Union Trust Bldg., Pittsburgh, Pa.**

**New York Chicago Detroit Memphis Houston St. Louis**

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failures of human beings, roadway facilities should be designed and applied which are, as far as possble, inherently safe; that is, they should be so constructed that the failures in the human elements may be rendered of little importance.

Along a roadway such as this, it would of course be impossible without great expenditures of money (which would be almost prohibitive) to re-construct this roadway in such a manner that all of the "safeguards" now known to the highway engineer might be applied. There are, however, many "safeguards" which can be applied without prohibitive expenditures of money and which will enable a reduction in accidents of a sufficient amount to make such expenditures economically proper.

Such remedies might include:

1. Construction of a center island of adequate width converting this highway into a divided roadway.
2. Modification of traffic control signals to that of up-to-date equipment making possible a more uniform flow of traffic and eliminating many of the unnecessary stops and needless delay now experienced.
3. Application of proper and adequate highway lighting.
4. Construction of grade separations at a few of the major and hazardous crossings.

[This interesting review of the general accident experience over a 2-year period along New Jersey's most heavily traveled trans-state highway is taken from a paper presented by Mr. Arnold H. Vey, Traffic Engineer of the New Jersey State Highway Department, before the Association of Highway Officials of the North Atlantic States. The road in question was State Highway Routes Nos. 25 and 26 from the Holland Tunnel to the Trenton Traffic Circle—Editor.]

▼

## Census Seeks Facts on Motor Transportation

The United States Bureau of the Census is now taking a census of the commercial motor vehicle transportation business. Enumerators are canvassing all bus and truck operators in the United States that do a for-hire business.

Only sworn employes of the Bureau of the Census are permitted to examine the individual returns, access to them being denied even other governmental agencies, under the law. No information that would reveal facts and figures contained in the returns will be disclosed. When the canvass is completed, however, data in the individual reports will be consolidated to provide a measure of the extent and character of this important type of transportation.

The valuable results of this census will be available to all persons interested in motor vehicle transportation. Reports will be issued as soon as returns are received from all operators and the figures tabulated.

▼

## "Military Highways" Reach 69,000 Miles

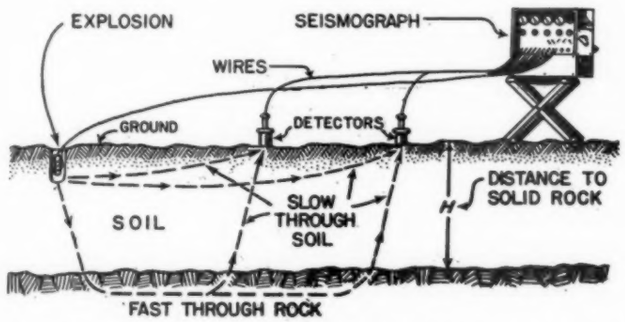
The war Department has classified 69,823 miles of highway as "military priority roads," according to compilations made by the National Highway Users' Conference on the basis of an official map issued by the Department. That mileage is equivalent to more than one-half the total length of Federal-aid highways.

"First priority" designation is given by the Department to 23,429 miles of highways, these being thus characterized as holding prime importance in national defense. Second priority roads total 32,230 miles, while the third priority rating covers 14,164 miles of roads.

## Pick-up of Sound Waves Locates Underground Rock

By precise timing of sound waves racing through earth and through earth and rock, engineers of the Bureau of Public Roads have developed practical field methods for determining the distance below the ground surface to solid rock. These engineers have perfected an instrument by which measurements can now be made on the surface with apparatus that will indicate within a few feet how far below the surface rock will be found. The measuring instrument is a highly sensitive electrical device known as a seismograph. The method saves the time and expense of drilling to find out how deep the rock lies.

Accurate results are obtained by measuring the speed with which an impulse from the explosion of a buried




*Sketch Showing Method of Using the Measuring Instrument*

blasting cap or small charge of dynamite travels through the ground. Such an impulse will travel through soil at a speed of 1,000 to 6,000 ft. per second but the speed through rock is 16,000 to 20,000 ft. per second. A cap is exploded in the ground and at the same time the electric current exploding the cap causes a record to be made with precise apparatus for measuring time. Special detectors are placed at different distances from the explosion and pick up the impulse as it comes through the ground. The detectors are electrically connected with the time-recording device and the time of travel of the impulse from the explosion can be measured to a small fraction of a second.

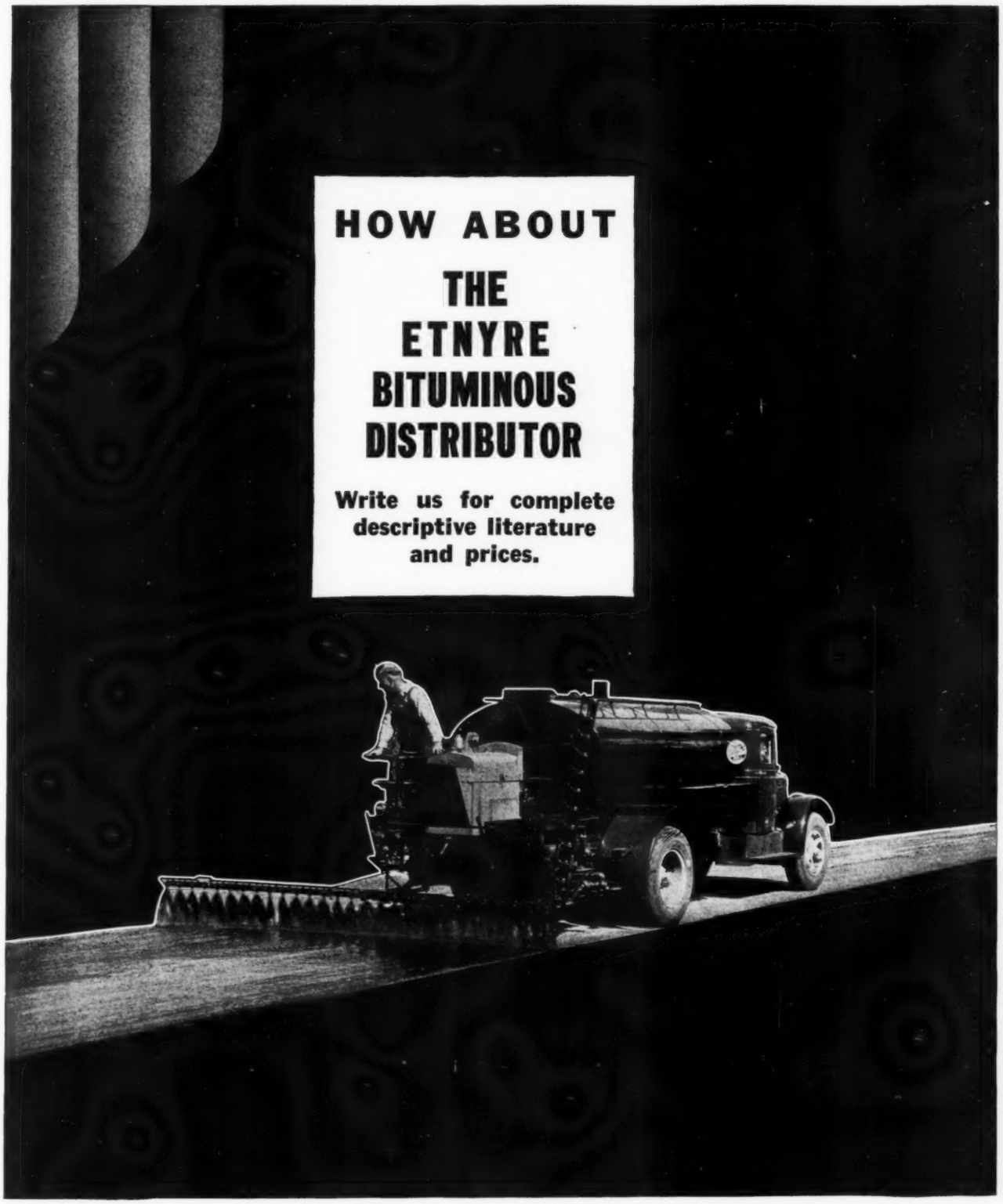
When a detector is close to the explosion one impulse coming through the soil is received. At a greater distance an impulse coming through soil is received and a second one moving down through soil to rock, through rock, and from the rock up to the surface arrives a fraction of a second later. At still greater distances the impulse moving through soil and rock arrives ahead of the impulse moving more slowly through soil alone. Knowing the speed of travel through soil and through rock and the time of travel through different distances it is possible to calculate how far the impulse went downward through soil before it encountered rock.

This method has been used extensively in prospecting at considerable depth for oil. Elaborate and costly apparatus has been used. The Bureau of Public Roads has now developed simplified apparatus that is giving excellent results.

▼

"I call therefore a complete and generous education that which fits a man to perform justly, skillfully, and magnanimously all the offices, both private and public, of peace and war."

Milton—*Of Education.*

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# SNOW DRIFT CONTROL BY NATURAL BARRIERS

DURING the last several years the Engineering Experiment Station at Michigan State College, East Lansing, Mich., has been conducting a research project in snow drift control. The investigation on artificial snow fences was covered in Bulletin No. 57, issued in 1934 by the station. A study is now being made in natural snow fences and all information derived from this will be published as a bulletin when the studies are completed. In a paper presented Feb. 19 at the annual Conference on Highway Engineering at the University of Michigan, E. A. Finney, Associate Professor of Civil Engineering, Michigan State College, gives the following interesting information on natural snow fences:

The natural barrier, or snow fence, consists of trees or shrubs planted in rows or groups in such a way as to slow down the normal velocity of the wind and produce a drift. This type of snow control is best adapted to wide right-of-ways and localities where permanent snow fences may be left in place the year around. The natural barrier fits in very nicely with the modern trend towards highway beautification.

It is quite obvious that the arrangement of the trees in the planting will affect the results produced by the barrier as a whole. Considerable data are available on the various planting arrangements of the trees for windbreaks. There seems to be no fixed rule as to what is the best method of planting. One must rely upon experience and judgment as to the best arrangement of the trees and rows.

In present practice the trees when planted vary in height from a few inches to several feet. Local conditions, available stock, and cost are, no doubt, the deciding factors when it comes to planting. As it takes from 4 to 6 years to grow a tree of effective height, many advantages are gained by planting the higher tree. The high trees give immediate protection and beautification with a low maintenance cost, but a high first cost. The smaller trees have a low initial cost, but require years of maintenance against grass, weeds, fire, theft and cutting off by machines, factors which should offset the higher cost of the more effective trees.

*Tree Planting Arrangements.*—The present tree planting arrangements may come under any one of these three groups, the single row barrier, the double row barrier and the multiple row barrier.

1. The single row barrier to be effective must be planted very close. The trees are allowed to take their natural growth or are topped each year to form a dense hedge. This type of planting is suitable for narrow right-of-ways and spots where the more open and wider barriers can not be used. The spacing of the trees will depend upon the maturity height of barrier, the shape of the tree to be planted and the kind of tree.

2. The two row barrier is used quite extensively. The trees are planted either close together in each row to form a tight barrier, or loosely and staggered to form a more open barrier. The trees are planted from 3 to 4 feet apart and thinned as they grow up, or they are spaced several feet apart and allowed to take their natural growth.

3. The multiple row barrier may consist of three or more rows of trees. The usual number is five rows of trees. The trees are usually spaced from 8 to 10 feet apart in the rows and the rows may vary from 5 to 15 feet apart.

In the case where deciduous trees are used instead of evergreens, the tall trees are placed on the lee side of the barrier and low growing shrubs are planted on the windward side to prevent the wind from sweeping under the trees.

In general, it may be said that the planting arrangement will depend upon:

1. The width of the right-of-way, the length of the barrier and the topography and development of the lands adjacent to the highway.
2. The specie of trees to be used and their growth, spread, hardiness and tolerance.
3. Ample spacing for moisture and feeding area for the roots.
4. The age to which the belt will be allowed to grow.
5. The facilities for cultivation and maintenance between the rows and the type of machinery to be used.
6. They should be planted close enough to get the benefits sought and keep down the weeds and grass.

The trees best adapted for use in the natural snow barrier are the evergreens, including the Pines, Spruces, Firs and Cedars. Low spreading shrubs, such as Buffalo Berry, Buck Thorn, Willows, Barberry and others are used in various combinations, with Box Elders, the Green Ash, the White Elm, the Caragana, the North West Poplar, and other trees that have a suitable branch development.

The effective area of a tree barrier will average about 16 feet from the edge of the trees to each foot of tree height. This distance has been checked by measurements in the field and by wind tunnel tests. A barrier consisting of only one row of trees will have a less effective area per foot of height due to the openings between the tree tops, which are not sealed as in the case of the double row.

The growth of the trees should be rapid and consist of dense branch growth which will remain close to the ground. The yearly growth of a coniferous tree may vary from three or four inches to 18 inches depending on soil, climate and moisture conditions. A fair average may be taken as 12 inches per year which will cover most of the varieties. The Spruces, Firs and Cedars are the most tolerant, that is, they can be planted in groups, or close together without shedding their lower branches. Their foliage is quite dense, more so than the pines. The Norway Spruce is considered one of the best trees because is is a fast grower, very tolerant, dense and will do well under most conditions.

Under planting may be necessary when the older trees become large and shed their lower branches. The opening must be filled with some specie that is very tolerant and will stand shading.

To break the effect of uniformity in plantings, the rows may be irregular in number with the greater depth at points where the drifting is most serious.

Our prairie states have found it necessary to plant deciduous trees and shrubs in localities where evergreens will not stand the severe conditions. The barrier usually consists of several rows with the taller trees

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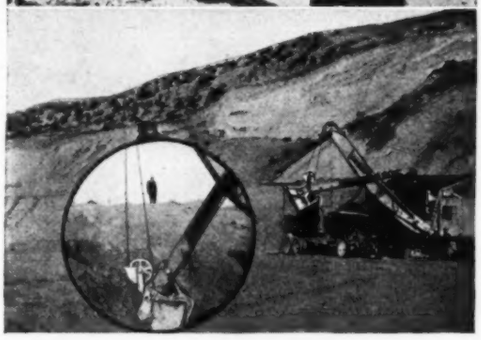

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AMSCO Renewable Lip Dippers effect such great savings in added yardage handled, and speed up digging operations so much that they often show appreciable savings over the cost of keeping old dippers in operation.

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AMSCO Renewable Lip Dippers are made in all sizes from ½ to 18 yards for all makes of shovels, with back lugs arranged to fit any dipper stick. Get details and prices today from your shovel manufacturer or our nearest office!

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on the inside rows and the low growing shrubs are planted in the windward rows to prevent the wind from blowing under the trees.

*Shrub Planting for Snow Control.*—Very little use has been made, if any, of our flowering shrubs as a source of material for snow barriers. There is no reason why they could not be used, and they certainly would work into a highway beautification plan more readily than a long monotonous row of evergreens.

A shrub suitable for use in a snow barrier should be very hardy, it should have strong, flexible branches to withstand high winds and snow and ice deposits, tolerant to sun or shade and grow under adverse soil and climatic conditions.

There are a large number of shrubs, both of the native and domestic varieties that will come under these specifications. They are either tree-like in shape like the Magnolia, Hawthorn and Sumac, or upright like the Mock Orange, Caragana, Japanese Quince, or of the drooping type like the Red Dogwood, Barberry and Spirea.

All planting should be harmonious and adapted to the locality and should usually be native stock. The use of native stock has three distinct advantages: First, native plants harmonize with the plant character of the surrounding country. Second, native plants are hardier under roadside conditions than are imported or developed plants. Third, native plants require less maintenance. In some cases, it is desirable to use non-native stock as an addition to the native species.

In planting, the shrubs should be selected for their winter appearance as well as summer appearance. It is possible with the varieties available to have continuous bloom from early spring to late fall, and throughout the winter there are the berries and colored barks that will blend in with the winter landscape.

The planting arrangement at each drift spot will require careful consideration. It will be necessary to consider the length of planting, thickness of the planting, height of shrubs, distance from the roadway, a solid or open planting, arrangement of the shrubs for effectiveness and local conditions.

During the last few years roadside improvement has been given a great deal of consideration. There is no reason why a planting along the roadway cannot serve a two-fold purpose of snow fence and beautification.

▼

## Congress of International Association for Bridge and Structural Engineering

The International Association for Bridge and Structural Engineering will hold its 2nd International Congress from Oct. 1 to 8, 1936, in Berlin, attendant upon an invitation from the German Government. The German Government has accepted the patronage of the Congress and has already officially invited the various States to designate a delegation for the Congress. The invitations contain a preliminary list of the reports and contributions to the discussion. The following themes will be dealt with:

(1) Importance of the toughness of steel for calculating and dimensioning steel structural work, especially when statically indeterminate.

(2) Stressing and degree of safety in reinforced concrete structures, from the designer's point of view.

(a) Influence of continuous and of repeated loading.

(b) Means for increasing the tensile strength of concrete and for reducing the liability of cracking.

(c) Adoption of high-tensile steel.

(d) Influence of joints of concreting and of dilatation.

(3) Practical questions in connection with welded steel structures.

(a) Influence of dynamic and frequently alternating loading on welded structures. (Research work and its effect on practice.)

(b) Design and execution of welds with special consideration of thermal stresses.

(c) Inspection and control of welded joints.

(d) Experience with completed structures.

(4) Recent points of view concerning the calculation and design of bridge and structural engineering in reinforced concrete.

(a) Walled structures.

(b) Wide-span bridges.

(5) (a) Theory and research work on details of steel structures of welded and riveted construction.

(b) Application of steel in bridge construction.

(c) Application of steel in hydraulic construction.

(6) Concrete and reinforced concrete in hydraulic engineering. (dams, pipe lines, pressure galleries, etc.)

(7) Research concerning building ground.

The various reports of the Congress will be published in the three official languages (German, English and French) in separate volumes; moreover a special telephone installation will be provided for, allowing the participants in the Congress to follow the Congress work in each of the three Congress languages.

Besides the technical and scientifical work the Committee of Organization in Berlin (President Dr. Todt, General Inspector for German Roads) will organize several excursions and visits to important structural works. The official closing meeting of the Congress will take place in Munich on Oct. 10, 1936. The Secretariat of the International Association for Bridge and Structural Engineering, Swiss Federal Institute of Technology in Zurich, will give any information desired on this matter.

▼

## Technologic Improvements Since the War

But it will surprise most of you, as it did me, to find that the vast increase in industry of all kinds, that occurred in the years between the close of the war and 1929, was carried on with steadily decreasing consumption of coal and metals. We have learned to make more kilowatt hours of electricity and haul more ton-miles of freight with a less total consumption of coal. From 1917 to 1932, the average consumption of coal per kilowatt hour decreased from 3.5 to 1.47 pounds. The most modern plants use less than a pound per kilowatt. Today we can take one of our ordinary locomotives and melt it up and remake the same tons of metal into a locomotive that will pull more than twice as many ton-miles of freight per year, and do this with about two-thirds as many pounds of coal per ton-mile. The end of these technologic improvements is not in sight. There is a vast amount of work to be done by engineers in improving our best practices, and another vast amount to be done in replacing our outmoded and inefficient and unprofitable practices and equipment with the better things we already know of, that has been proven by use and experience.—From address by William Otis Hotchkiss, President Rensselaer Polytechnic Insitute at Mid-Winter Reunion of Alumni Association of the Institute.

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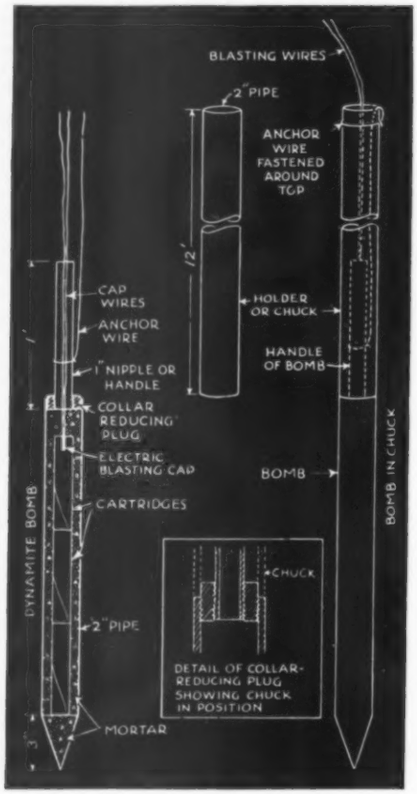
# CHANNEL EXCAVATING WITH DYNAMITE

IN connection with the construction of the Short Route Highway through a section of Athens County, Ohio, it was necessary at three points to deepen the channel of Wolf Creek for a total distance of 1.3 miles. This stream is winding and rocky. The average width is 50 ft., with irregular fluctuations in depth of from 3 ft. to 8 ft. The channel bed is of shale and sandstone composition, too rocky for efficient dredging and too irregular for ordinary ditching. The specifications called for a uniform channel 8 feet in depth, and after three different contractors had abandoned the project, the Johnson Co., of Trimble, O., accomplished the task in record time by the use of dynamite bombs. How this work was handled is described in The Du Pont magazine. The actual excavating was done in 140 working hours, using 1,700 lbs. of nitroglycerin dynamite, 600 electric blasting caps, 6,000 ft. of copper wire and 1,500 ft. of 2-in. iron pipe.




*Details of the Dynamite Bombs*

The bombs were made in advance, using 30-in. sections of the pipe, the bottom ends of which were welded to a point after cutting out four gores. Next, concrete mortar was poured in to a depth of about 3 in. and permitted to harden. Then, in each shell was loaded, end to end, the required number of cartridges, and the last one inserted carried an electric blasting cap, with insulated copper connecting wires. To seal the charge, more concrete was poured in, and then a 1-in. reducing plug was screwed into the collar of the pipe. Above that, similarly attached, was the nipple or "handle" extending about 1-ft., and through the hole along the axis of this piece, the cap wires referred to were threaded, thus completing the assembly. These details are more clearly shown in the illustration.

When the blasters were ready to start work, a supply of these bombs were stored in a rowboat which was anchored at the desired location in the middle of the creek. A bomb was placed in a chuck or holder—a section of 2-in. pipe 10 to 12 ft. long—through which the leading wires were drawn up and left free. Next, the bomb was secured in the holder by means of a wire between the bomb handle and the top of the chuck. These preliminaries completed, the outfit was pushed down into the bed of the stream. The holding wire was cut and the chuck used to drive the bomb to the required depth.

The chuck was then carefully withdrawn, leaving the bomb planted in the bed. One of the workmen next attached the free end of the cap wires to a piece of wood floating at the surface, and the planting process was resumed and continued until ten or more bombs were set. This work completed, the cap wires were connected in series, then taped securely and joined to the leading wires which extended from the boat to the terminals of the blasting machine, a safe distance away on the shore. When everything was in readiness, all the charges were shot together.

The bombs were spaced 8 to 12 feet apart, usually in the center of the channel, and side shots were used only where jutting rock ledges made them necessary. The channel shots loosened the stone and silt so thoroughly that much of the material was quickly carried away by the swift current. Large blocks of broken rock were maneuvered to the shore by man power, and the remaining burden was removed by scrapers.

The use of bombs eliminated the drilling of holes, at a substantial saving in labor and time. A crew of three men, operating in shifts on the boat, did all the necessary planting, while a fourth man handled the blasting machine. And a crew with barge and scraper completed the job.

▼

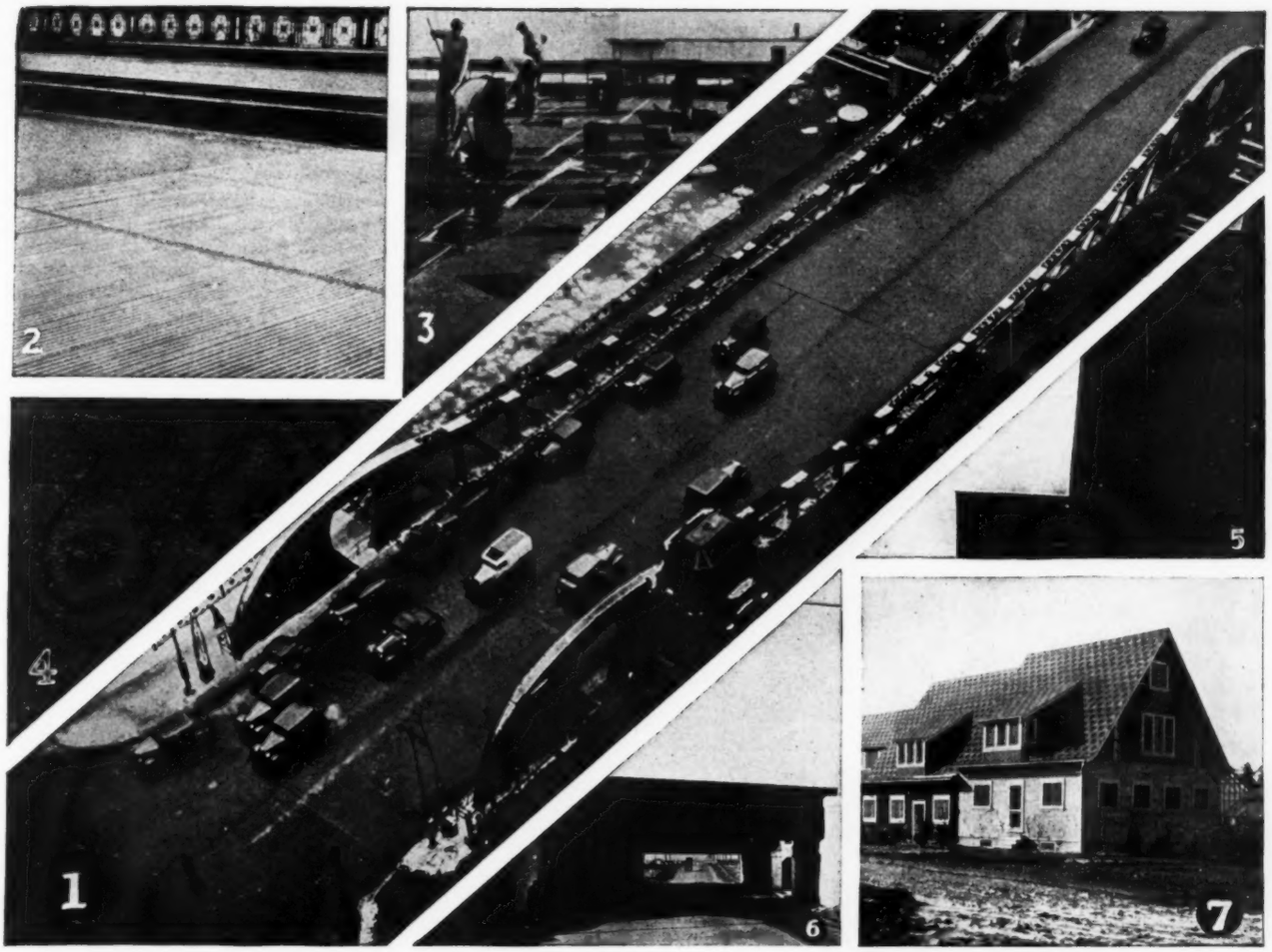
## Motor Travel Volume Ten Times Rail Total

The volume of passenger traffic on the highways is more than ten times as great as the corresponding volume registered by the railroads. And the railroads, even in their best "passenger year," have never carried more than one-seventh the volume of passenger traffic which now moves over the highways, according to computations made by the National Highway Users' Conference on the basis of Interstate Commerce Commission data and other statistics.

These facts are interesting in the light of the recent Interstate Commerce Commission order under which all railroad lines are to charge two cents a mile, instead of slightly more than three and one-half cents, for carrying passengers. The order is based upon the theory that the reduced fares will help the railroads to "recover passenger business which they have lost" to automotive transportation, including private vehicles and bus lines that are commercially operated.

Discussing figures upon which the I. C. C. order centers attention, Roy F. Britton, Director of the National Highway Users' Conference, states:

"The situation is this: If only one-fifteenth of the highway passenger traffic—measured in terms of passenger-miles—were to return to the railroads under the new order, the railroads would do passenger business at the rate they marked up in their banner year of 1920."




# Servicised
# ASPHALT PLANKING

More than seven years ago Servicised standard bridge planking was laid on Chicago's LaSalle Street bridge, Figure 1. Today the same material with no replacements or repairs gives promise of providing a perfect wearing surface indefinitely. Figure 2 shows Servicised Sementread non-skid planking for bridges. Specifying asphalt plank for roof decks has become common usage with many architects since the World's Fair, Figure 3, proved its practicability. Figure 4 shows Servicised Rock-Surfaced non-skid planking for bridges. Time proven standard asphalt plank is used wherever a tough but resilient wearing surface is required—see Figure 5. Recently completed 95th Street underpass, Chicago, Figure 6, has Servicised asphalt plank protecting its membrane waterproofing from puncture by railroad ballast. Figure 7 shows standard and Sementread planking for building and power plant construction.

In addition to the above-illustrated, more common uses of Servicised asphalt plank, it is regularly specified for industrial floors and loading platforms, as a protection for corkboard walls of refrigerator rooms, and as filler for steel channel bridge floors. Where wearing quality and lightness in weight is desired use asphalt plank. Servicised will give you service on your requirements of asphalt planking of any type, for any use, anywhere, anytime.

Servicised Premoulded Bituminous Specialties too numerous to mention, can solve many a construction problem better, saving time and money as well. Send our engineering department details of your special requirements or problems. If premoulded bituminous material can be used Servicised can make it.

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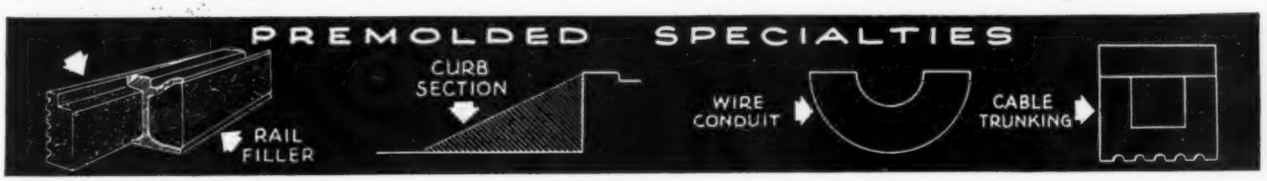


# NEW EQUIPMENT AND MATERIALS

## New Dragline

A dragline with extra long working range in the 2½ to 3 cu. yd. capacity class has been announced by the Marion Steam Shovel Co., Marion, O. This is a Marion clutch type machine, Type 39-A, designed especially as a dragline.

Equipped with an 85 ft. boom it will readily handle the capacity of a 2½ cu. yd. Page R. C. Bucket, or a 3 cu. yd. bucket with

*Marion Type 39-A Dragline*

an 80 ft. boom. The Marion Type 39-A has unusually large, wide spread crawlers which provide for very low ground pressure. These crawlers measure 40 in. by 19 ft. 9½ in. They are of the self-cleaning, non-clogging type typical of all clutch type machines built by Marion.

Other outstanding features of the new Marion Type 39-A Dragline include: hook rollers to relieve center pin stress; antifriction bearings throughout; and all-welded underframe construction of the new type. The machine is powered with either a Gas or Diesel engine.

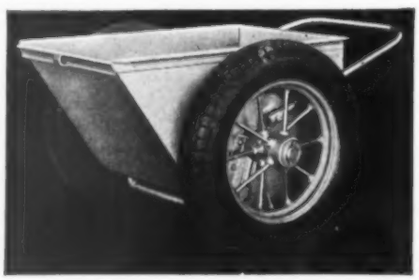
The Marion Type 39-A follows closely in the steps of the Marion Type 38-A, another Marion clutch type dragline announced recently.

With the addition of these two draglines to the Marion Line of clutch type excavators, Marion is now in a position to meet the material moving requirements of any construction job calling for excavators from ¾ cu. yds. and up.

▼

## Pneumatic Tired Concrete Carts

All three sizes of the recently announced CMC concrete and material carts (6½, 9 and 11 cu. ft. capacity) manufactured by Construction Machinery Co., Waterloo, Iowa, have been improved by the installation of Timken tapered bearings in the balloon pneumatic tired wheels.



*CMC Concrete and Material Cart*

Standard size 18 in. x 5.25 in. four-ply balloon tires are used. These are more than ample for the larger 9 and 11 ft. carts and on the smaller outfit have the advantage of being available in all parts of the country.

CMC carts are described in a booklet just released. A copy will be gladly sent on request.

## The New Model "C" Littleford Pressure Distributor

Several refinements have been made recently to the Model "C" pressure distributor of Littleford Bros., Cincinnati, O. A new larger Viking positive pressure pump with 4 in. inlet and outlet connections is now used. The Littleford four position valve, while remaining basically the same, has been improved and provided with 4 in. openings to correspond to pump. Incidentally, this one valve entirely controls the entire operation of the distributor and is actuated by a plainly marked handwheel.

A new type of fifth wheel drive for truck tachometer has been designed. It has a 16 in. x 4 in. pneumatic tired wheel with angle type drive (having no exposed gears). It is impossible for stones and bitumen to interfere with it. A tachometer on pump is now standard equipment.

Full 3 in. opening quick acting gate valves are used on the manifold bar so that distributor may be filled from either side, spray with half of spray bar or use one hand-spray. An improved type of quick acting coupling has been utilized on filler ports, spray bars and handspray attachment.

A new alloy that is especially heat resistant has been used in the combustion tube. The heating system, using one low pres-

*New Model "C" Littleford Pressure Distributor*

sure burner that requires no preheating and serves to thaw out pump valve and the one short pipe line used, has remained practically unchanged. The continuous heat flue which heats material very quickly and efficiently is an important feature.

An air cleaner on air blower is now used. A new type of clutch on blower and fuel pump drive has been designed. All pipe connections are either flanged or welded, eliminating leaky joints.

Full information, literature and prices may be obtained from Littleford Bros., 453 E. Pearl St., Cincinnati, O.

▼

## New Diesel Compressor of 50% Less Weight

A new line of portable compressors has been announced by Schramm, Inc., West Chester, Pa.

These "Utility" compressors operate through direct drive from either gasoline or Diesel engine at approximately 1200 R.P.M The compressor unit is six cylinder, of small bore and stroke and light weight reciprocating parts. Because of the light weight castings which can be used for this design the manufacturer claims a saving in weight of 50 per cent or more.

Other features of design include mechanical intake valve actions which is stated to assure perfect timing of air entering pistons and at the same time allow full area of compressor head to be devoted to discharge valve.

The Schramm "Utility" compressors also use a full force feed lubricating system, which is a guarantee of long wear. Unloading is controlled by air pressure regulating the action of unloading valves.

These compressors are built in four sizes with actual air deliveries of 105, 210, 315 and 420 cu. ft. free air per minute at 100 lbs. pressure. They are offered in a complete assortment of portable running gears.

## BIG PRODUCTION—LOW COST

This fast, portable, easily operated Trackson tractor shovel digs and loads up to 40 cubic yards per hour—*with only one man.* 7 foot dumping clearance. Wide range of usefulness—digging, loading, subgrading, stripping, cleaning up, bulldozing, leveling, excavating, 3 heights, crawler or wheels, ½ or ¾-yard buckets, bulldozer attachment. Write for Catalog RS4 to Trackson Company, Milwaukee, Wisconsin, U. S. A.

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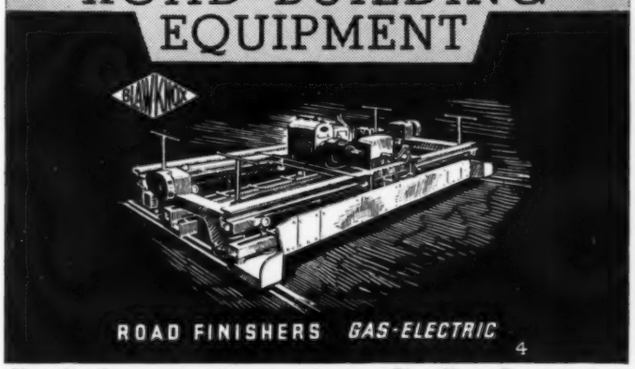


New developments and improvements in Blaw-Knox Construction Equipment are right in step with today's program.

With a background of years of practical experience, Blaw-Knox equipment is trustworthy. It is economical and low in maintenance. Designed to stand up under severe operating conditions, it is fitted to the job by skilled engineers. It helps immeasurably to fulfill contracts speedily and profitably.

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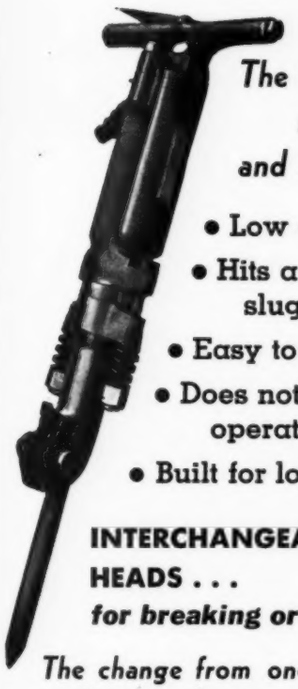
*Includes:—*
BATCHERPLANTS · ROAD FINISH-SPREADERS (Manuel or Automatic) · TRUKMIXERS
BULK CEMENT PLANTS · Trukmixer Loading Plants
ROAD FORMS · DIRTMOVERS · BULLDOZERS
STEEL STREET FORMS · TAMPING ROLLERS ·
ROAD FINISHERS · CLAMSHELL BUCKETS · (Gas-Electric) · CONCRETE BUCKETS
CEMENTANKS · STEEL BUILDINGS · STEEL GRATING
Literature on any of the above BLAW-KNOX Products will be sent upon application.

# A POWERFUL TWO-PURPOSE TOOL

## *for heavy demolition and sheeting work...*

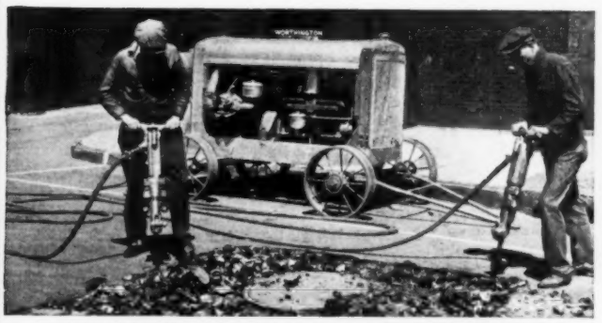


The **WORTHINGTON MASTER BREAKER** and **SHEETING DRIVER**

- Low air consumption
- Hits a hard slugging blow
- Easy to operate
- Does not wear operator down
- Built for long life

**INTERCHANGEABLE HEADS . . .**
***for breaking or driving***

*The change from one type of tool to the other is quickly made by removing two head bolts*



**WORTHINGTON AERO-2-STAGE PORTABLE COMPRESSOR, 105 cu. ft. Steel Wheel Towabout Model, operating two WORTHINGTON No. 10 MASTER BREAKERS**

● ***Literature on request***

**WORTHINGTON PUMP AND MACHINERY CORPORATION**
**General Offices: HARRISON, NEW JERSEY**
A-36224 *Offices and Representatives in Principal Cities*

**WORTHINGTON**

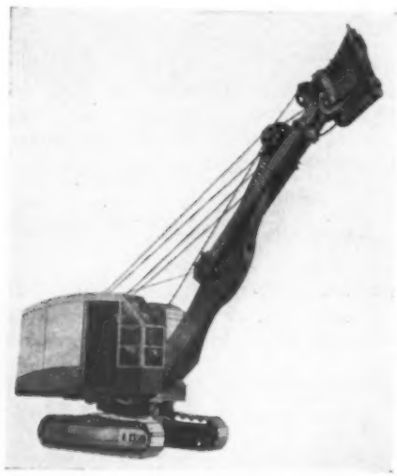
*Model 210 Schramm "Utility" Compressor, Powered by Buda Diesel Engine.*

These "Utility" compressors can be secured with Buda gasoline or the latest type "Lanova" Diesel engine; both types of engines operating at maximum efficiency at speed employed by the manufacturer. The manufacturer has prepared new printed matter covering these types and can be secured by writing Schramm, Inc., West Chester, Pa., and requesting bulletins No. 3605 and 3607.—(R. S.)

▼

## New Excavator

A new ⅝-yd. shovel, dragline, crane and trench hoe has been put on the market by the Koehring Co., 3026 W. Concordia Ave., Milwaukee, Wis. This is a high-speed, light weight machine, designed according to the latest developments and progress of engineering skill. Koehring heavy duty construction has been employed throughout. The use of high strength special steels, combined with welded construction and simplified design has produced a machine of exceptional strength, with a substantial decrease in weight. It is claimed to have remarkably high speed, great operating ease and exceptional traction and steering flexibility. The 251 is fully convertible, with a ¾ yd. rating as a crane or dragline. Attachment changes are easily and quickly made on the job. Many special Koehring features are incorporated in this new, thoroughly tested, and proven excavator. Easy operation is an outstanding advantage of Koehring excavators. A simple gear shift provides two selective swing speeds to best synchronize with the arc of swing and height of lift for increased output. Two traction speeds give greater power in tough going and faster speed in easy traveling. Positive steering for any angle is easily accomplished from the lever position in the cab. Full vision from the cab operating position assures maximum production. Safety glass protects the operator. Convenient and free accessibility of all parts is a definite time-saver when adjustments are necessary. Each shaft can be independently removed. Drums are equipped with quickly removable barrels. Gears are enclosed and run in oil bath. Anti-friction bearings eliminate power waste.



*New Koehring 251 Excavator*

## New High Tensile Steel

To meet an increasing demand for a special high-tensile steel, Armco H. T.-50 has been developed by The American Rolling Mill Co., of Middletown, O.

Tests on specimens show the impact tensile strength is 5,000 foot pounds per square inch, nearly double that of mild steel, but great care has been taken to avoid strength in excess of actual requirements. This readily permits the use of advanced methods of fabrication and welding. Armco H. T.-50 has a sufficiently high yield point to be used on jobs with the highest practical stresses, but still maintains sufficient ductility to be adaptable for varied fabrication.

While the endurance limit of Armco H. T.-50 is 48,000 lbs. per square inch, the yield point is 47,000 lbs. per square inch in the hot rolled grades. Very few materials, the company emphasizes, offer an endurance limit equal to or greater than the yield point.

Tensile strength is 67,000 lbs. per square inch in the hot rolled grades and 70,000 in cold rolled. Elongation in 2 in. is 28 per cent in hot rolled sheets.

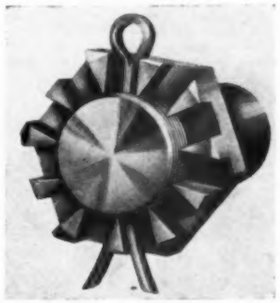
Because welding is now an accepted method in the assembly of structures that will be moved continually at high or low speeds, the carbon is confined to a very low percentage. Strength has been obtained by other additions. Finished welds closely approach the unwelded parts in physical properties. Sheets and plates can be welded with many varieties of the so-called shielded arc electrodes.

Atmospheric corrosion resistance of Armco H. T.-50 is four to six times that of ordinary steel. Sheets and plates are offered in 20-gage and heavier, in all the finishes and sizes ordinarily supplied in mild steel hot and cold rolled grades.

▼

## Cooke Micro Slotted Nut—With Closer Adjustments

The Blatchford Corporation, 80 E. Jackson Blvd., Chicago, has started production on the Cooke micro slotted nut—with closer adjustments.



*Cooke Micro Slotted Nut*

This nut offers from 10 to 22 adjustments per turn (depending on size) instead of the usual 6 per turn. This micromatic adjustment is achieved by locating the keying wedges off center from one another so that two keying positions are possible for each slot. At keying position, a wedge centers the hole. If hole and wedge are not in keying position at first trial, a slight tightening will bring a wedge into position at one end or the other of the hole, for the key can be inserted from either end. Because of this closer adjustment (from .008 in. to .013 in., depending on size) there never is an occasion for blocking off the nut to get a keying position, or of tightening with shims.

The key is set by simply tapping it in with a hammer. No pliers needed. The key spreads automatically, curving outward, and filling the space between wedge and sides of the hole, locking bolt, nut, and key immovable. A special key accompanies each nut. The end of the key is trimmed off to an internal V-shape so that it spreads readily around the keying wedge on the nut, never catching on the wedge. The smoothly curved shape of the key when set gives the Cooke Micro Slotted Nut a neat, workmanlike appearance when installed.

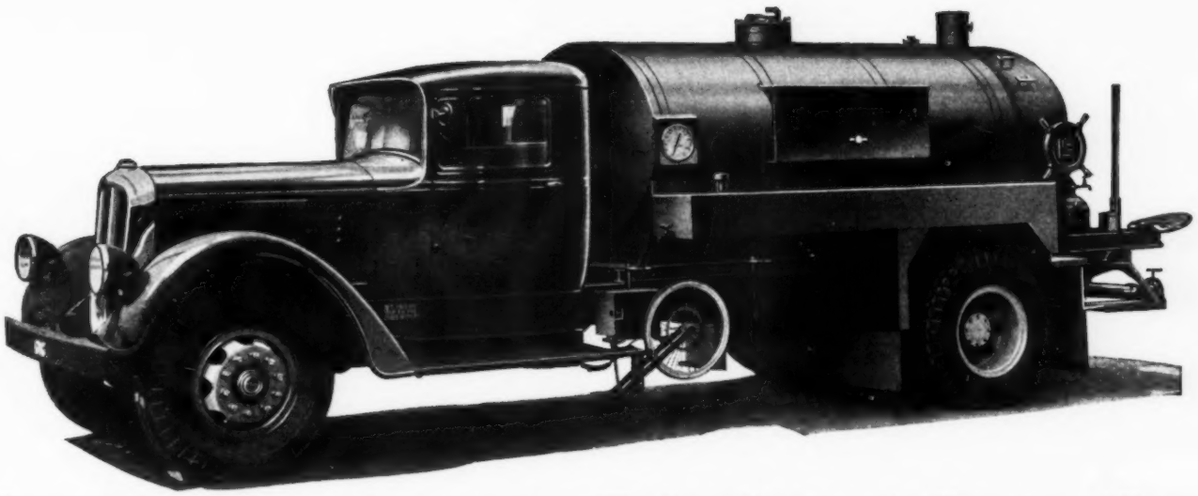
It is claimed that Cooke micro slotted nut will stay tight far longer, thus preventing wear from vibration, and that it can be applied in far less time than standard slotted nuts.

▼

## New Scraper-Loader

The Sauerman scraper-loader, a crawler-mounted drag scraper machine, completely portable under its own power, has been announced by Sauerman Bros., Inc., 488 So. Clinton St., Chicago.

This new machine combines the long range capacity of the drag scraper with the direct loading action of the usual mechanical loader. It is suited to any work that requires hauling mate-



# New Feature Prevents Dripping at Spray Bars

● A new feature, exclusive on Littleford Distributors, sucks all material in the lines back into the tank the instant spray is cut off. That gives you instant cut-off at spray bars and prevents dripping. There is no material left in the lines to dribble out or freeze up.

This feature requires no complicated system of valves. No moving parts. It is based on a sound engineering principle. Therefore, it is thoroughly dependable, absolutely fool-proof and requires no adjustments or maintenance.

Write at once for complete information on Littleford Pressure Distributors. Sizes 500 to 2,000 gallons capacity.

**LITTLEFORD**

***Road Maintenance Equipment***

**SINCE 1900**

THE SIGN OF A GOOD HEATER — LB — LITTLEFORD BROS. CINCINNATI, OHIO

**LITTLEFORD BROS. 454 E. PEARL ST. CINCINNATI, O.**

---

**PIONEER**

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## THE LATEST "DOPE"

● —on the most economical and practical method of stabilizing gravel roads with clay and calcium chloride or salt.

● This simplified and illustrated booklet has just come off the press — it's brand new — and it's yours for the asking.

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Without obligation please send your new booklet "STABILIZED ROADS"

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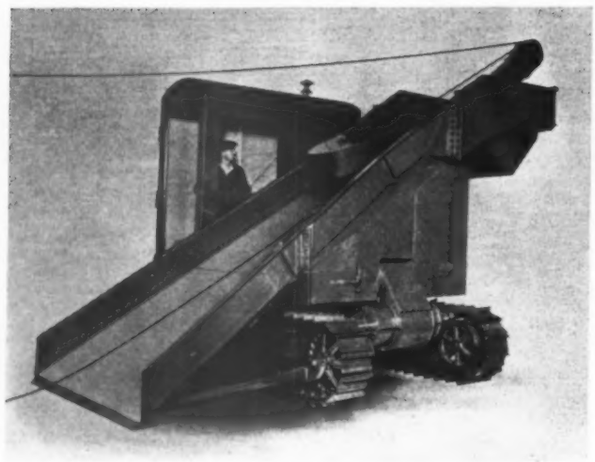


*Sauerman Scraper-Loader, ½-Yd. Model.*

rials from a pit, bank or stockpile and loading the materials into trucks or other form of transport. One man operates the machine and he has just four simple levers to handle; two of these levers control the scraper and the other two control the steering and travel of the machine.

Sauerman scraper-loaders are offered in four sizes, equipped with Crescent scraper buckets of ½, ¾, 1 and 1½ cu. yd. capacities.

▼

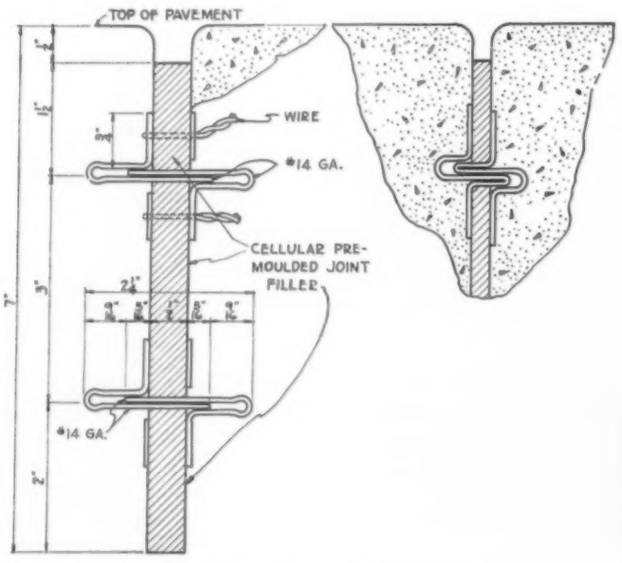
## New Expansion Joint

A new means of load transmission for expansion joints in concrete pavement has been developed by the Highway Steel Products Company, Chicago Heights, Ill., makers of the well-known Translode joints. Alternate types are shown in the illustration.

In this unit the function of adequate load transmission is accomplished by means of a novel design of the steel which thus shaped is claimed to provide a positive seal at top and bottom of the joint thus accomplishing both purposes of load transmission and effectual seals, at the cost of the load transference unit alone.

It is announced that tests of this means of load transmission show it more effective than dowel bars on 1 ft. centers and it is claimed for it that it is much easier to accurately place.

The device is adapted for use with all types of premoulded filler.




*Alternate Types of New Expansion Joint*

## A New Hypressure Jenny

The Homestead Valve Manufacturing Company, Coraopolis, Penn., who for several years has been manufacturing high pressure vapor spray cleaning equipment under the trade name of Hypressure Jenny, announce their entry into the low-priced cleaning equipment field with a new unit.

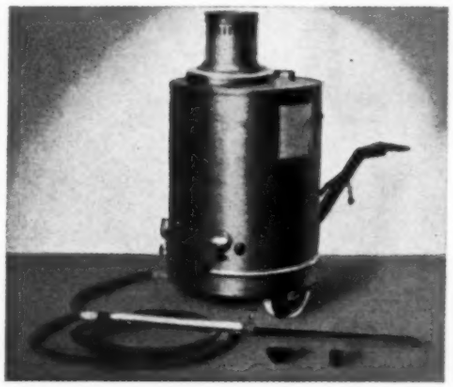
This new unit, to be known as Model G, is operated on the same principle as previous models. Cleaning is accomplished by means of applying through a nozzle to the surfaces to be cleaned, a combination of water vapor, hot water and cleaning chemicals, over a pressure range from 50 to 150 lbs. per square inch.

The unit is fully contained, carrying water, solution and oil tanks, oil burner, vapor generator, water and solution pump, electric motor and a specially constructed vapor hose with a variety of shaped nozzles.

Vapor pressure is developed by means of a vertical-spiral-parallel-coil type vapor generator, and is controlled by an automatic pressure control switch. The vaporizing oil burning system burns standard kerosene or light furnace oil. Pilot flame is obtained by manual ignition, but is retained automatically after starting.

Both temperature and pressure are held within narrow limits of variation.

A saturation selector enables the operator to change the spray and have a wetter or dryer vapor as needed to obtain the proper



*Model G Hypressure Jenny*

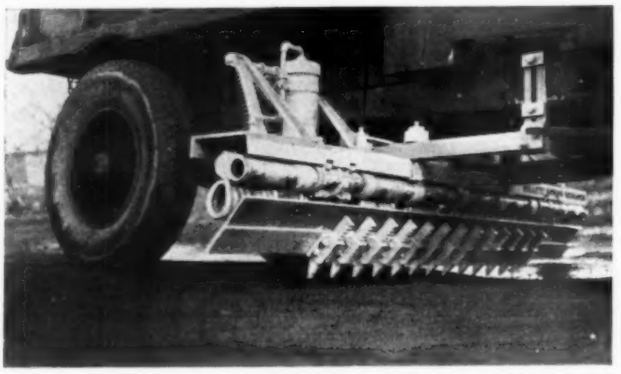
operating effect. Paint thus may be stripped by using very hot water containing a strong alkali; or by adjusting the spray and pressure, tar or very heavy grease may be blasted off.

Model G Jenny is made in both stationary and portable types.

▼

## New Scarifier

An adjustable tooth scarifier attachment for the Willett spring scraper has been brought out by the Willett Manufacturing Co., Plymouth, Ind. The scarifier can be mounted on the scraper and has been used very successfully in cutting out ice ruts and in shallow scarifying jobs. Models and sizes of spring scrapers are manufactured for all makes of trucks, 1½ ton and up. The Willett spring scrapers are now manufactured by the Willett



*Willett Scarifier Attached to Spring Scraper.*

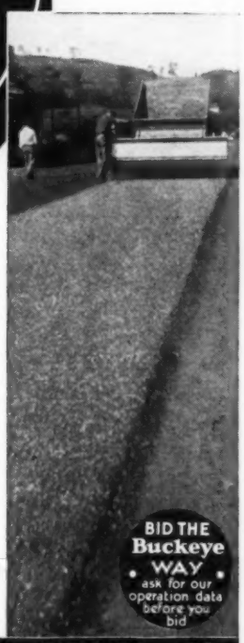
## ??—IF—??

IF you need a finishing machine — any size, any type, with any special feature—if you have a tough job, then use a FLEX-PLANE Finisher.

Headquarters for Finishers, Spreaders, Dummy Joint Installers, Expansion Joint and Dowel Rod Spotters.

**FLEXIBLE ROAD JOINT MACHINE COMPANY**
**WARREN, OHIO**

USE THE
**Buckeye**
*Surface Material*
SPREADER
*for Positive Accuracy*



**PLACES MATERIAL** ✓
exactly where wanted, working to a definite line, any width up to the full width of the machine. No material scattered. No clean-up gang needed.

**DISTRIBUTES IT** ✓
in exactly measured amounts, spreads evenly over each square yard of road. Accuracy is not affected by variations in speed of operation. Here, at last, is a machine that makes possible strict adherence to engineers' specifications.

Saves Time - Saves Material

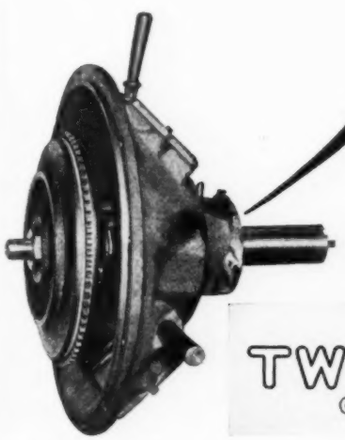
BID THE Buckeye WAY
ask for our operation data before you bid

THE BUCKEYE TRACTION DITCHER CO.
FINDLAY, OHIO

**"Best fitted to our application" that's *one* reason the Thew Shovel Co. of Lorain, Ohio, gives for equipping "Lorain" shovels, draglines, clamshells and cranes with the Twin Disc Clutch.**

**Like so many other makers of road building, material handling and construction machinery, Thew has found that Twin Disc Clutches not only simplify design and operation of their machines but effect important economies in production. And, after using Twin Disc Clutches for ten years, Thew engineers *should be* competent judges of Twin Disc performance.**

***Write for specific recommendations.* Engineering data on request. *Twin Disc Clutch Company*, 1340 Racine Street, *Racine, Wisconsin.***



*Twin Disc 7751-G. T.*
*Gear Tooth*
*Power Take-Off Unit*

TWIN DISC CLUTCHES

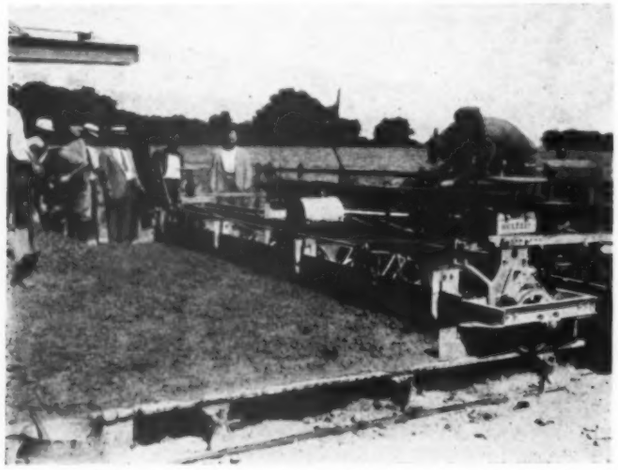
Manufacturing Corporation at Plymouth, Ind. They recently purchased the plant and equipment of, and are successors to, the Lee Trailer & Body Co. of Plymouth, Ind., pioneer manufacturers of dump bodies, loaders and semi-trailers. The Willett Manufacturing Corporation is continuing the manufacture of dump bodies and semi-trailers in addition to its regular line of road machinery, the spring scrapers, snow plows, road and street sweepers, etc.

▼

### New Internal Vibrator

The illustration shows the new Flex-Plane internal vibrator brought out recently by the Flexible Road Joint Machinery Co., Warren, Ohio. This attachment was used recently on the Erie Contracting & Excavating Co. job at North Benton, O.—width of pavement 20 ft. Heltzel steel forms were used to support the vibrator and vibrating finishing machine.

The attachment consists of rigid transverse frame supported independently on springs and rubber tired wheels to eliminate the vibration on the steel road forms. The entire frame is vibrated by a mechanical vibrator. The transverse shaft attached to the



*New Flex-Plane Internal Vibrator on Ohio Road Job.*

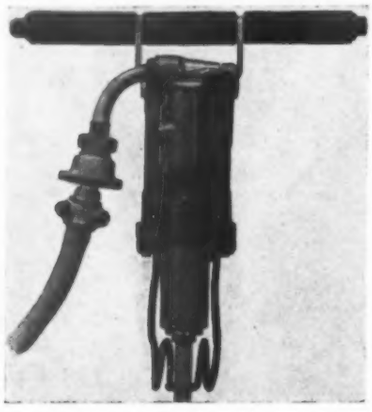
frame supports 150 rotating vibrating elements, which penetrate the concrete and move in and out to a depth of 5 in.

Immediately following the internal vibrator is the Flex-Plane 20-in. surfacing screed, which was equipped for forward and backward screeding. The same machine installed the longitudinal and transverse contraction joints. The concrete had a ¼-in. slump. The same machine was equipped for surface vibrating.

▼

### New Auger Drill

A new drill designed especially for drilling soft material has been added to the line of the Sullivan Machinery Co., 307 North Michigan Ave., Chicago, Ill. The drill, by means of a simple change, can be made into a machine which will give good performance in hard rock.



*Sullivan New H-2 Auger Drill*

The H-2 was purposely designed for auger drilling and is, therefore, stated to be, especially adapted for use in drilling soft iron ore, anthracite, gypsum, limestone, slate, shale, frozen ground, or any heavy, sticky formation, because of its tremendous stalling torque resulting in an extra strong rotation. Stalling, consequently, is greatly minimized, and the result is a superior auger drill.

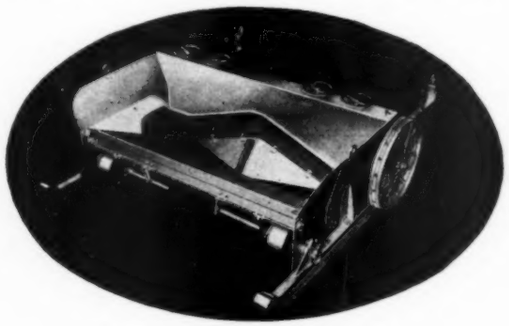
Some of the features claimed for this drill are:

1. Superior drilling speed in auger conditions.
2. Ease of operation.
3. Low upkeep cost.

▼

### New Adjustable Spreader

Easy pull, permitting use with the newer model Fords and Chevrolets, as well as larger trucks, is a feature of the new adjustable spreader designed by The Jaeger Machine Company, Columbus, O., for laying stone, macadam and bituminous, both base and top. Main load is carried on 36-in by 4-in. steel wheels, which operate on hard surface outside area of new material. Smoothness of spread is insured by mounting screed on floating



*New Jaeger Adjustable Spreader.*

runners, which ride the high spots independent of ups and downs of the wheels, thus insuring filling out of all irregularities in subgrade.

Adjustability for 8 to 11 ft. widths of spread is built into the machine, eliminating "carrying back" and hand filling of narrow strips on roads up to 24 ft. wide. Provision is made for blending joints by bleeding material from gate on either side.

Cost of the machine is said to be little more than that of ordinary spreader boxes, and it is stated it will lay gravel, rock, slurry, chert, armor plate, and hot or cold bituminous mixes, to depths of 1 in. to 10 in. of uncompacted material. It is stated, two Jaeger spreaders, used in parallel, have laid up to 2000 tons of pavement in a day.

▼

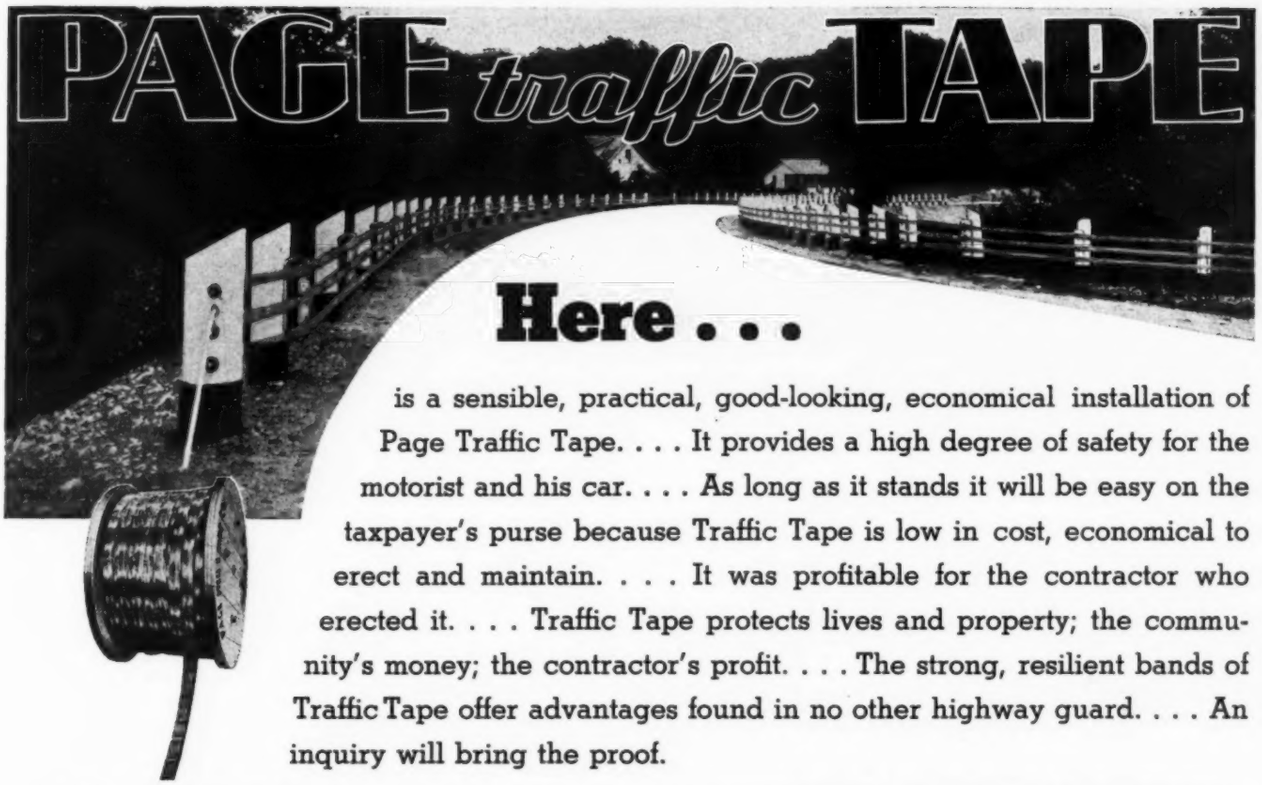
## WITH THE MANUFACTURERS

### National Tractor Meeting to Be Held at Milwaukee

The Society of Automotive Engineers will hold a National tractor meeting April 15 and 16 at the Schroeder Hotel, Milwaukee, Wis. A Highway Machinery Session will be held on Wednesday morning. A paper, "Tractors and Industrial Power Equipment in Highway Maintenance and Construction," will be presented by E. L. Roettiger, State Highway Engineer, Wisconson State Highway Commission. The discussion will be by H. B. Dodge, Four Wheel Drive Auto Co.; O. E. Eggen, Oliver Farm Equipment Co.; John S. Erskine, International Harvester Co.; H. S. Eberhard, Caterpillar Tractor Co.; and D. A. Milligan, Cleveland Tractor Co.

On Wednesday afternoon there will be a demonstration trip through the plant of the Waukesha Motor Co. On Wednesday evening there will be a U. S. Army Mechanization Session, at which a paper, "Automotive Ordinance and Mechanization," will be presented by Major John K. Christmas, Ordnance Department, U. S. Army. The discussion will be by E. F. Norelius, Allis-Chalmers Manufacturing Co.; George T. Moore, Wisconsin Axle

# PAGE traffic TAPE



## Here . . .

is a sensible, practical, good-looking, economical installation of Page Traffic Tape. . . . It provides a high degree of safety for the motorist and his car. . . . As long as it stands it will be easy on the taxpayer's purse because Traffic Tape is low in cost, economical to erect and maintain. . . . It was profitable for the contractor who erected it. . . . Traffic Tape protects lives and property; the community's money; the contractor's profit. . . . The strong, resilient bands of Traffic Tape offer advantages found in no other highway guard. . . . An inquiry will bring the proof.

**PAGE STEEL & WIRE DIVISION OF THE AMERICAN CHAIN COMPANY, INC., MONESSEN, PENNSYLVANIA**

District Offices: New York, Pittsburgh, Atlanta, Chicago, San Francisco

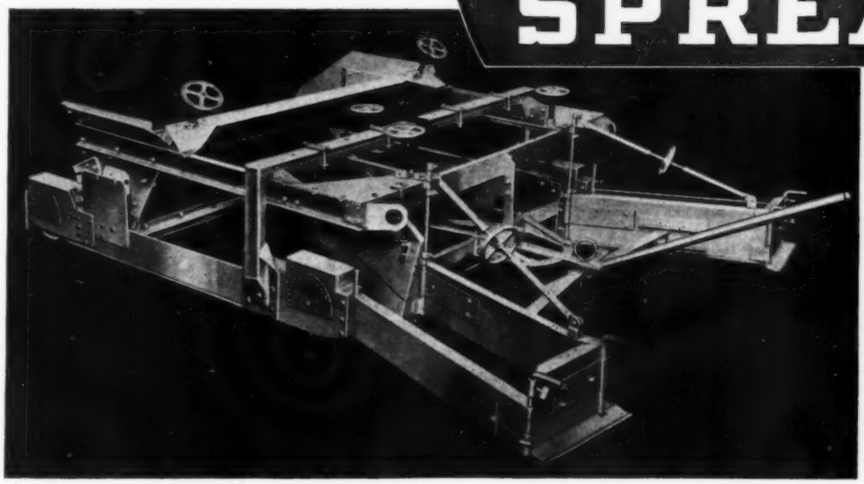
*In Business for Your Safety*

# NEW ECONOMY *in Spreading and Finishing!!*

*With the*

## BLAW-KNOX Road FINISH SPREADER

*Know More About This Simple, Low Cost Road Building Unit . . .*



The Blaw-Knox ROAD FINISH-SPREADER will spread and finish stone or gravel; hot or cold asphalt—one to fifteen feet wide—half a road at a time. Will lay varying widths on curves fully or partially banked—*with one machine at a fraction of the usual cost.*

Ask Blaw-Knox to send you Catalog No. 1523—"The Blaw-Knox Road Finish-Spreader."

BLAW-KNOX COMPANY

2003 Farmers Bank Bldg., Pittsburgh, Pa.

*Offices and Representatives in Principal Cities*

Co.; A. W. S. Herrington, Marmon-Herrington Co.; and J. E. Hale, Firestone Tire & Rubber Co.

An Aircraft Engine Session will be held on Thursday morning. A paper, "Air Cooled Radial Engine Performance Possibilities and Means for Obtaining Optimum Fuel Economy in Flight," will be presented by Raymond W. Young, Wright Aeronautical Corporation. The discussion will be by J. B. Fisher, Waukesha Motor Co.; H. G. Smith, Hercules Motor Corporation; T. B. Rendel, Shell Petroleum Corporation; and D. P. Barnard, Standard Oil Co. (Indiana).

These papers will be presented at the afternoon session:

"Tractor Engine Fuels—A Theoretical Analysis and Practical Test Results—In the Laboratory and the Field," by Earl Bartholomew, Ethyl Gasoline Corporation; and A. W. Lavers, Minneapolis—Moline Power Implement Co.

"Diesel or Gasoline—Which Engine Will You Have?" by Ralph C. Chestnut, Cleveland Tractor Co.

"Gasoline Versus Kerosene for Tractor Fuel," by Professor R. I. Shawl, Department of Agricultural Engineering, University of Illinois.

The discussion will be by J. M. Davies, Caterpillar Tractor Co.; John S. Erskine, International Harvester Co.; C. E. Frudden, Allis-Chalmers Manufacturing Co.; Elmer McCormick, John Deere Tractor Co.; Walter G. Ainsley, Sinclair Refining Co.; George A. Round, Socony-Vacuum Oil Co.; Robert E. Wilkin, Standard Oil Co. (Indiana).

It is not necessary to be a member of the S. A. E. in order to attend the meeting and guests are welcome and are cordially invited to participate in the discussions.

▼

## Kauffmann Again Heads Link-Belt

At the annual meeting of shareholders held at the Stevens Hotel, Chicago, March 24, Alfred Kauffmann was elected president of Link-Belt Company. Mr. Kaufmann succeeds George P. Torrence, whose resignation as president and director of the company was accapted by the board on the previous day.

*Alfred Kauffmann*

Mr. Kauffmann started with the company 35 years ago as a draftsman. His career has included many responsibilities, such as designing engineer, superintendent of construction, sales engineer, vice-president and manager Link-Belt plant at Philadelphia, vice-president in charge of Link-Belt Dodge and Ewart plants at Indianapolis, and for the past four years first vice-president in charge of the company's Chicago plant operations. He was president of the company from 1924 to 1932, and has been a director since 1922.

The four board members elected to fill the terms expiring this year are—Wellington Wells, Boston; J. Reece Lewis, Philadelphia; B. A. Gayman, San Francisco; Alfred Kauffmann, Chicago.

Mr. Wells is returned to the board after an absence of three years. He had been a Link-Belt director from 1922 to March, 1933, at which time he resigned because of ill health.

Mr. Lewis is a member of the banking firm of Elkins, Morris & Co., Philadelphia.

Mr. Gayman is president of Link-Belt Company Pacific Division, with headquarters at San Francisco, and has been associated with the company for 39 years.

## Hyatt Roller Bearing Inventor's Associate Passes on at 86

Charles S. Lockwood, who worked along with John Wesley Hyatt on the invention of the Hyatt roller bearing, died in Newark, March 20, in his 86th year.

As an active member of the Hyatt experimental laboratory staff almost up to the time of his passing, Mr. Lockwood's career covered 62 years of service in the employ of John Wesley Hyatt and the companies Mr. Hyatt founded. More than 44 of these years were devoted to the Hyatt Roller Bearing Company, since its incorporation in 1892.

At a "60 years of service" testimonial dinner tendered to him by his Hyatt associates in December, 1934, it was recorded that in 1874, when a lad in his twenties, he joined forces with Mr. Hyatt. Just prior to that Mr. Hyatt had invented celluloid, and Mr. Lockwood came to Newark to serve as manufacturing superintendent of the Celluloid Corporation. Later he took over a similar position in another Hyatt enterprise, the Bonsilate Company of Albany, New York, manufacturers of plastics.

In the late 80's he returned to Newark, N. J., and worked with Mr. Hyatt on the sugar cane crushing machinery then occupying Mr. Hyatt's talents. From a bearing problem encountered on this machine was the Hyatt roller bearing conceived to overcome the difficulty. It did the job so well that after a few years the sugar machine idea was passed on to other hands, and Mr. Hyatt formed the Hyatt Roller Bearing Company with Mr. Lockwood as Chief Engineer. It is interesting to note the prolific inventive minds of those two "partners," John Wesley Hyatt and C. S. Lockwood. In the name of Mr. Hyatt, who lived to be 83, there are upwards of 250 patents, and records show Mr. Lockwood to have nearly 100 patents in his name, too.

This venerable "co-founder" of their company will be greatly missed around the Hyatt plant. For not only was he a great inventor but a fine fellow, loved by all as the name of affection "Pop" Lockwood, bestowed on him indicates, for "Pop" he was for years to his Hyatt associates, many of whom worked along with him for several decades, but still juniors to this congenial octogenarian.

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## Noland Now Toncan Distributors

Noland Company, Inc., of Washington, D. C., has been appointed Toncan Iron sheet distributors, according to an announcement by N. J. Clarke, Vice-President in Charge of Sales of Republic Steel Corporation, Cleveland, O.

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## James L. Medler Dies

James L. Medler, Assistant Treasurer and Assistant Secretary, Universal Atlas Cement Co., died March 9 of a heart attack.

Mr. Medler was one of the company's veterans, having been with it for about 35 years. He joined the former Atlas organization in 1901 as clerk, organized its claim department, had charge of its credits and advanced to the positions of Assistant Treasurer and Assistant Secretary which he held during the last 25 years.

Prior to coming to Atlas, he was for 11 years connected with the Central Railroad of New Jersey. For two years he was President of the New York Credit's Men's Association and for four years Treasurer of the Crescent Athletic club, Brooklyn, which had a membership of 2,600 and annual expenditures of about a million dollars.

After completing his early high school and collegiate education and entering industry, he studied law nights, received a Master's degree in law and was admitted to the Bar of the State of New York.

Due to his long experience in the cement field Mr. Medler was widely known in the industry and among credit men and had many friends who will feel keen personal sorrow over his passing.

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## H. T. Moore New President Tuthill Spring Co.

At a special meeting of the Board of Directors of the Tuthill Spring Co., Chicago, Mr. H. T. Moore was elected President, succeeding Mr. Frank H. Tuthill, deceased. Mr. Moore has been with the Tuthill Spring Co. for nearly 20 years, being Vice-President for the last five years. Mr. W. S. Van Bergen was elected Vice-President, and remains in charge of production. Mr. J. H. Schmidt was elected Secretary. Mr. O. C. Nuss remains as Treasurer.

## "My Kinneys cost less to operate,"

*says a prominent Eastern Contractor.*

Reasons for the Kinney Distributor's superiority are many: its large Kinney pump of extra capacity; the accuracy with which it measures bitumen onto the road; its uniform heating; the number of days it is working and not laid up for repairs; and its simple operation with one lever interlocking all necessary controls—spray valves, circulating valves, and air blowing.

***Write or wire the nearest office for Bulletin A and prices on the sizes you need.***

## ★ KINNEY ★
**MANUFACTURING COMPANY**

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DALLAS 710 Santa Fe Bldg.
PHILADELPHIA 725 Commercial Trust Bldg.
LOS ANGELES 1333 Santa Fe Avenue

## Sauerman LONG RANGE Excavators

HUNDREDS of contractors are reducing their costs on cut-and-fill work, canal excavation, construction of earth dams and embankments, production of concrete aggregates, etc., by using Sauerman Excavators.

These contractors are able to handle large, complicated jobs with a minimum equipment investment because a Sauerman Excavator saves the expense of having separate machines for digging, hauling and elevating.

*Write for Catalog*

**SAUERMAN BROS., INC.**
**488 S. Clinton St. CHICAGO**

The larger of the above views shows a Sauerman Slackline Cableway cleaning out a canal, while the smaller view is of a reservoir job.

Sauerman Crescent Drag Scrapers are widely used for digging sand and gravel.

## REPAIR YOUR ROADS NOW

### *to prevent further damage*

What a beating highways took last winter! Prolonged snow and ice which covered highways throughout the country took its toll in pot-holes, cuts and cracks, entailing untold damage. To prevent further damage to these streets and roads, which represent a huge investment, repairs should be made at once.

The Barber Asphalt Company products listed below are recommended for making quick, lasting and economical repairs to all types of construction:

*Barber Brand Winter Cold Patch*—For repairing holes and cuts in *all types* of roads and streets. It is an asphalt binder cut back with a volatile solvent. To be mixed cold with local crushed stone or other mineral aggregate. Furnished in drums.

*Barber Brand Cold Repair Cement*—An emulsified asphalt that requires no heating. Will flow from a drum at ordinary temperature. Can be mixed with local aggregate. Good for repairing all types of roads. Can be used for reinforcing or extending shoulder of road.

*Genasco Crack Filler*—For repairing cracks in concrete pavements. An adhesive, bituminous product made with Trinidad Lake Asphalt. Shows greater adhesion to dry concrete than blown asphalts. Furnished in drums.

AMERICAN ROAD BUILDERS' ASSN. 1902 MANUFACTURER

Fill out the coupon below for complete information on each of these products.

**THE BARBER ASPHALT COMPANY**
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ADVERTISING PAGES REMOVED



### Wallace Now With Tractor & Equipment Co.

Kenneth Wallace, formerly engaged in the sale of industrial equipment in Iowa, recently has joined the Tractor & Equipment Co.'s organization, 433 South Jefferson St., Chicago, Ill., where he will specialize in the sale of industrial tractors and Diesel engines.

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### Robert E. Smith Now With Inland Steel

Norbert E. Smith has been employed by Inland Steel Co., Chicago, as a member of their sales department, with headquarters in Chicago. He will cover certain territory in the states of Indiana, Ohio and Kentucky. Mr. Smith has been associated with Joseph T. Ryerson & Son, Inc., for the past 15 years, the last seven of which he was in their sales department, located at Indianapolis, Ind.

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### Lyle W. Johnson Now General Manager, Kesl Co.

Mr. Lyle W. Johnson, who has been a sales manager of the Joseph Kesl Tractor & Equipment Co., distributors, 1510 North 13th St., St. Louis, Mo., since September 27, 1934, became general manager on April 1. Mr. A. M. Spooner, who has been working the territory for the company for some time, succeeds Mr. Johnson as sales manager. The other officials of the company are Mr. Joseph Kesl, president; Mr. L. May, vice-president and treasurer, and E. F. Kreutz, credit manager.

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### New Distributor for Hobart in Southern California

The Hobart Brothers Company, Troy, O., announces J. C. Gowing Welding Equipment & Supply Co., Jim Gowing, manager, has been appointed exclusive distributor for Hobart electric arc welders in Southern California. Their new location is at the corner of Laura and Regent, Huntington Park, Calif. Additional information may be had by calling Jefferson 3777.

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### "Caterpillar" to Exhibit at Midwest Power Expo

Caterpillar Tractor Co. of Peoria, Ill., will be represented at the Seventh Midwest Power Exposition to be held in the International Amphitheater Building, Chicago, April 20-24, company officials have announced.

The product to be displayed will be the D8800 40KW Diesel-electric generating set. This unit consists of a "Caterpillar" 4-cylinder, 80-brake horsepower Diesel engine direct-connected to a General Electric generator, and is in the middle of the company's line of five Diesel power unit and industrial engine sizes ranging from 160 to 44 maximum brake horsepower.

"Caterpillar" exhibit will occupy 200 sq. ft. of floor space. Displays will include a novel assembly exhibit showing the detailed working of the Diesel fuel injection system.

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### Dow Chemical to Increase its Capital Stock

At a meeting held March 24 at Midland, Mich., the board of directors of the Dow Chemical Co. decided to call a special meeting of the stockholders to be held on April 21, 1936, to amend the company's articles of incorporation by increasing the authorized shares of non par value stock from 1,000,000 to 2,000,000 and to authorize 60,000 shares of 5 per cent cumulative preferred stock. The company has now outstanding 30,000 shares of 7 per cent cumulative preferred stock, which under the proposed amended articles may be exchanged share for share for the new preferred stock. The company proposes to redeem on Aug. 15, 1936, any of its present outstanding preferred stock which shall not in the meantime have been so exchanged. The company also intends to offer for sale to its holders of non par value stock, in proportion to their holdings, additional shares of the new preferred stock at $105 per share. There will be no present offering of any non par value stock. The company's purpose in amending its articles of incorporation at this time is to accomplish the retirement of its present 7 per cent cumulative preferred stock by issuance of new 5 per cent cumulative preferred stock. The proceeds from sale of additional shares of the new preferred stock will be used for plant betterments, extensions, and the increase of working capital.

## NEW LITERATURE

*Air Compressors*—Sullivan Machinery Co. brought out a new bulletin on its line of Unitair Compressors. The Unitair is a two-stage, completely air cooled, V-type, single acting stationary compressor incorporating many advanced features in compressor design. Write for Bulletin 88-O, Sullivan Machinery Co., Dept. 21, Michigan City, Ind.

*Road Machinery*—A condensed catalog of its equipment has been issued by the J. D. Adams Co., Indianapolis, Ind. In it are included brief descriptions and illustrations of the Adams new line of leaning wheel graders, the new Adams heavy duty graders and the new retread paver for bituminous work.

*Bridge Bolting-Up Wrench*—A new 16-page bulletin, issued by the Ingersoll-Rand Co., features the use of the I-R impact wrench to save bolting-up time on bridge and building work on railroads. In the heading of the bulletin it is stated that these wrenches make a 72 per cent reduction in such bolting-up time. The new I-R "crawl-air" compressor, the regular railroad mounted units and a large variety of pneumatic tools, hoists, etc., are also shown. Copies of Bulletin 2219 may be obtained from Ingersoll-Rand, 11 Broadway, New York City.

*Simplified Design of Concrete Floor Systems*—A recently published booklet, "Simplified Design of Concrete Floor Systems," will save time in the design of all types of concrete floors. It also provides a quick means of determining the relative economy of the various systems. Formulas and tables in common use are included together with safe load tables for one and two-way solid slab and ribbed slab types. A description of each system is given and the merits of each under various conditions are enumerated. Copies may be had without charge upon request of the Portland Cement Association, 33 West Grand Ave., Chicago, Ill.

*Road Machinery*—An excellently illustrated and attractively gotten up booklet just issued by the Allis-Chalmers Manufacturing Co., Milwaukee, Wis., contains information on its entire line of road machinery. The booklet contains numerous illustrations of the equipment on the job. Concise specifications of the equipment also are included.

*Armco Drainage Products*—A 46-page catalog dealing with the use of Armco products for drainage purposes has been issued by the Armco Culvert Manufacturers' Association, Middletown, O. The products are briefly described and many of their uses are illustrated. Included is a section on determining culvert sizes, culvert length and location. Illustrations and diagrams are give showing the use of perforated pipe for highway purposes, such as curing frost ...., stopping slides, curing web cuts, intercepting seepage water. A section is devoted to the uses of Armco Multiplate for bridges, culverts, large waterways, etc.

*Tractor*—A catalog giving complete information on its Model "K" tractor has just been issued by the Allis-Chalmers Manufacturing Co., Milwaukee, Wis. The Model "K" is a 49 hp. tractor built in heavy duty series on earth moving, logging, farming or industrial jobs.

*Jaw Crushers*—A booklet dealing with its Jaw Crushers has been issued by the Pioneer Gravel Equipment Mfg. Co., 1515 Central Ave., N. E., Minneapolis, Minn. It contains a discussion of the various types of crusher work and the best type of crusher for each job. A chart also is included which will enable the operator to determine the percentage of any size that a crusher will produce at various settings.

*Asphalt Surfaces*—The Asphalt Institute, 801 Second Ave., New York City has just published an attractive illustrated folder intended as an aid to dealers in developing their "small-use" markets. The folder is provided with a display space for the dealer's name, and is supplied at non-profit prices in any quantity.

Detailed uses are enumerated under the general headings—Airports, Driveways, Filling Station Areas, Floors, Parking Areas, Sidewalks, Play Grounds and Sports, Revetment Uses, Railroad Uses and Roads and Streets. The qualities and adventages of asphalt for these uses are discussed briefly, some average maintenance costs are given, and a chart is provided showing the increasing tonnage of asphalt used for paving during the past 10 years.